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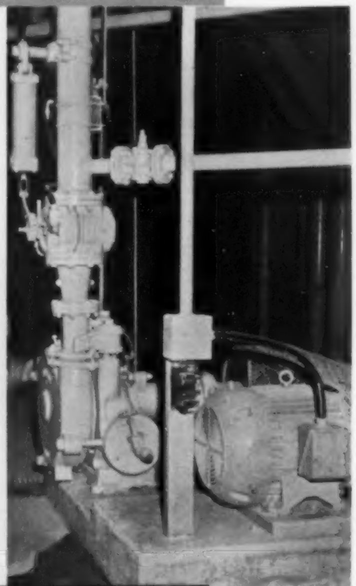

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COMING EVENTS

Oct. 4-5, SME Board Meeting, Brown Palace Hotel, Denver; AIME Board Meeting, Denver Hilton Hotel, coinciding with SPE Fall Meeting.

Oct. 5, AIME Colorado Plateau Section meeting. Talk by AIME President Joseph L. Gillson.

Oct. 5-7, AIME Rocky Mountain Minerals Conference, Utah Section host, Newhouse Hotel, Salt Lake City.

Oct. 5-8, 9th National Clay Conference, Purdue University, Lafayette, Ind.

Oct. 7-8, Third Quinquennial Alumni Reunion of Minnesota School of Mines and Metallurgy. Open House and technical session, banquet-dance; Northwestern vs Minnesota football game, University of Minnesota, Minneapolis.

Oct. 10-13, American Mining Congress, Mining Show (metal mining-industrial minerals convention, exposition), Convention Center, Las Vegas, Nev.

Oct. 17-18, Symposium on Surface Mining Practices, College of Mines, University of Arizona, Tucson, Ariz.

Oct. 17-19, Drilling and Blasting Symposium, sponsored by Colorado School of Mines, Pennsylvania State University, and University of Minnesota, Colorado School of Mines, Golden, Colo.

Oct. 24-25, AIME-ASME Joint Solid Fuels Conference, Daniel Boone Hotel, Charleston, W. Va.

Nov. 4, AIME Pittsburgh Section, Off-the-Record meeting, Penn-Sheraton Hotel, Pittsburgh.

Nov. 4-5, Joint meeting, AIME Central Appalachian Section and West Virginia Coal Mining Institute, Greenbrier Hotel, White Sulphur Springs, W. Va.

Nov. 7-10, Soc. of Exploration Geophysicists, annual international meeting, Galveston, Texas.

Nov. 15-16, Anthracite Conference, technical and scientific aspects of anthracite utilization, The Pennsylvania State University, University Park, Pa.

Nov. 18, American Mining Congress, coal division conference, Penn-Sheraton Hotel, Pittsburgh.

Dec. 3, AIME Colorado Plateau Section, technical meeting, election of officers, WAAIME dinner-dance, Grand Junction, Colo.

Dec. 5, AIME Arizona Section annual meeting, Pioneer Hotel, Tucson, Ariz.

Jan. 18, 1961, Third AIME Mechanical Working Conference, "Bar and Shaped Products," Penn-Sheraton Hotel, Pittsburgh, Pa.

Feb. 22-25, International Symposium on Mining Research, sponsored by U. S. Bureau of Mines and Missouri School of Mines and Metallurgy, Rolla, Mo.

Feb. 26-Mar. 2, AIME Annual Meeting, Ambassador and Chase-Park-Plaza Hotels, St. Louis.

April 10-12, 44th National Open Hearth Steel Conference and Blast Furnace, Coke Oven, and Raw Materials Conference, Sheraton Hotel, Philadelphia.

Apr. 12-14, International Symposium on Agglomeration, sponsored by SME, SPE, and TMS of AIME, Hotel Sheraton, Philadelphia.

April 26-27, AIME Technical Conference on High-Temperature Materials, Carter Hotel, Cleveland.

Sept. 17-20, Commemoration of the 50th Anniversary of Froth Flotation in the U.S.A., sponsored by AIME: Society of Mining Engineers' Mineral Beneficiation Division, Cosmopolitan Hotel, Denver.

Dec. 5, AIME Boston Section, Richards Night. Topic: New Developments in Mineral Processing. Speaker: Robert M. Garrels, Professor of Mineralogy, Harvard University.

Dec. 6-8, 19th Electric Furnace Conference, Penn-Sheraton Hotel, Pittsburgh, Pa.

MINING engineering

SOCIETY OF MINING ENGINEERS AIME

VOL. 12 NO. 10 **OCTOBER 1960**

COVER *The stripping of a bauxite deposit with a dredge has proven to be very effective and economical in Surinam, South America. Cover artist Herb McClure has depicted the dredge, named the "Akanswarie", at work in this locale. For pertinent information of this operation, see page 1083.*

FEATURE

ARTICLES

DEPARTMENTS

ABC

MINING ENGINEERING staff, Society of Mining Engineers, and AIME Officers are listed on the *Drift* page.

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PERSONNEL

THESE items are listings of the Engineering Societies Personnel Service Inc. This Service, which cooperates with the national societies of Chemical; Civil; Electrical; Mechanical; Mining, Metallurgical, Petroleum Engineers, is available to all engineers, members and nonmembers, and is operated on a nonprofit basis. If you are interested in any of these listings, and are not registered, you may apply by letter or resume and mail to the office nearest your place of residence, with the understanding that should you secure a position as a result of these listings you will pay the regular employment fee of 60 pct of the first month's salary if a nonmember, or 50 pct if a member. Also, that you will agree to sign our placement fee agreement which will be mailed to you immediately, by our office, after receiving your application. In sending applications be sure to list the key and job number. When making application for a position, include 8¢ in stamps for forwarding application to the employer and for returning when possible. A weekly bulletin of engineering positions open is available at a subscription rate of $4.50 per quarter or $14 per annum, payable in advance. Local offices of the Personnel Service are at 8 W. 40 St., **New York 18;** 57 Post St., **San Francisco;** 29 E. Madison St., **Chicago, 1.**

In addition to the listings below, ESPS maintains a more complete file of general engineering positions and men available. Contact nearest ESPS office, listed above. The New York office of ESPS will be open Thursdays until 7:00 P.M. for interviews.

MEN AVAILABLE

Exploration Geologist or Jr. Engineer, B.S. in geological engineering, 1960. Desires position in industry, preferably mining geology, or will accept mining engineering. Interested in technical sales work. Experienced in surveying. Location open. M-560.

Geologist-Engineer, B.S. degree. Qualified to direct mineral exploration in U.S. or abroad. Experience in bauxite, copper, and nonmetallics. Mining experience includes underground block caving and open pit operation. Speak Spanish. M-561.

Geologist, B.S. in geological engineering. Eleven years base metals, mine geology, and exploration; 4 years clay and bauxite; examination and evaluation of mining deposits. Prefer western U.S. M-562.

Manager, Industrial Engineer, 38. Master's degree in business. Twelve years as manager, superintendent, industrial engineer, chief engineer for medium-sized coal company. Experienced all phases underground coal mining including property evaluation and development. Registered engineer. M-563.

General Manager-Superintendent, 46. Fifteen years experience in metal mine operation, development, and exploration. Last 7 years in uranium. Hard worker, adaptable, gets results. Excellent record of successful, low-cost, high-production underground operations. Presently employed as manager, available on 30-day notice. Prefer U.S. or Canada. $12,000. Home: Colorado. Se-1262.

Geologist, geological engineering, 35. Two years supervising drilling and exploration crews on foundations and materials for Government. Three years assaying for base metals, nonmetals, and rare earths for Government. Also summer work in the field on oil structures, mapping, survey, dredge operations. $6000. Prefer foreign. Home: Alaska. Se-1489.

Mining Engineer, E.M. degree, 39. Sixteen years production and management experience in underground and open pit mining, ore beneficiation, agglomeration coal technology, and crushed stone processing. Registered professional engineer. Excellent references. $10,200. Prefer U.S. or foreign. Home: Minnesota, Se-1847.

Mining Engineer, E.M. degree, 40. Seven years experience including underground transitman-surveyor, instrument control, mapping and planning, dredging for gold and platinum and some concrete technical inspection; for mining and refining companies. $6000. Prefer Northwest, West. Home: Northwest. Se-1441.

General Manager or Executive Assistant, mining engineer, 51. Capable, responsible, 14 years diversified management experience. Fully experienced in operations, development, and exploration. Good nose for ore. $15,000 plus. Any location. Home: Nevada. Se-1400.

Geologist, 31. Four years in engineering geology, 2 years topographic work. Presently responsible for reports concerning materials and foundations of private projects. $7200. Prefer West. Home: California. Se-1530.

Exploration Geologist, 34. Eight years experience acquiring, managing, conducting exploration, developing studies for steel production, sand and gravel, and underground mining, $8400. Any location. Home: California. Se-1537.

Geologist, 30. Six years experience exploring, examination of uranium prospects, investigation of mineral prospects, surface and underground mapping, surveying, sampling on Pb-Zn-Ag, silver, gold, and mercury mines. $6500. Prefer western U.S., any. Home: California. Se-1511.

Geologist, geological engineer, 26. Three years experience in exploration, geological mapping, evaluating, estimating, diamond drilling, surveying on iron, molybdenum, porphyry copper; open pit and underground. $6900. Prefer Southwest. Home: Arizona. Se-1527.

Mine Engineer, Geologist, E.M. degree, 26. Several years experience including open pit design, mining studies, geological and topographical mapping, mining claim location, surveying, supervisor of exploration, installation of sampling equipment, operation of uranium mill for mining and milling companies. $6000. Prefer California. Home: Wyoming. Se-1582.

Mining Engineer, E.M. degree, Four years experience mine layout, design, use and application of modern coal mining equipment, studies of ventilation design and control, survey, equipment design, surface facilities, exploration drilling for coal and fluorspar mining. One year highway construction, planning. $7200. Any location. Home: Illinois. Se-1647.

Geologist, geological engineer, 32. Six years experience in geologic investigations, surface and magnetic surveys of iron orebodies, nonferrous examinations, underground and open pit, for mining and chemical companies. $7800. Any location. Home: Utah. Se-1599.

POSITIONS OPEN

Plant Superintendent, 30 to 40, for a large crushed stone and bituminous concrete manufacturing company. Engineering background desired. Salary commensurate with experience; excellent benefits provided by company. Some travel. Location, Pennsylvania. W9561.

Mining or Metallurgical Engineer, graduate, with 1 to 3 years experience, for process improvement studies in all phases of phosphate mining operations including prospecting, reserve evaluation, mining methods, and beneficiation. Salary commensurate with experience. Location, South. W9453.

Mining Engineer, B.S. degree, 28 to 38, to act in consulting capacity as member of central staff of mining and exploration group, analyzing current operations, methods, and recommending changes to be made. Should have 5 to 7 years experience in both underground and strip mining operations and experience with dragline operations. $7000 to $8000 year. Company will pay fee. 30 pct travel. Location, Chicago area. C8261.

Mine Engineer, graduate, 28 to 35. Five to 10 years experience including underground work, preferably in western mines. Coal mine experience desirable, able to carry out general mining engineering, supervise men, plan and administer. Design, survey, and construction supervisor for above and underground pumping and milling plants handling gilsonite ore. Will also serve as safety engineer. Under chief mine engineer and mine superintendent. Start $7200 to $9600, depending on qualifications, plus fringe benefits. West. Sj-5444.

Pilot Plant Superintendent, metallurgical or mining degree, 30 to 45. Experienced in pilot plant ore dressing operation (heavy media, jigging, spirals, flotation, magnetic separation) for iron ore operation. Working knowledge of Spanish desirable. Possible family housing after employment, after two or three months single status. For open pit mine operation. About $9600 plus benefits. Peru. Sj-5399-R.

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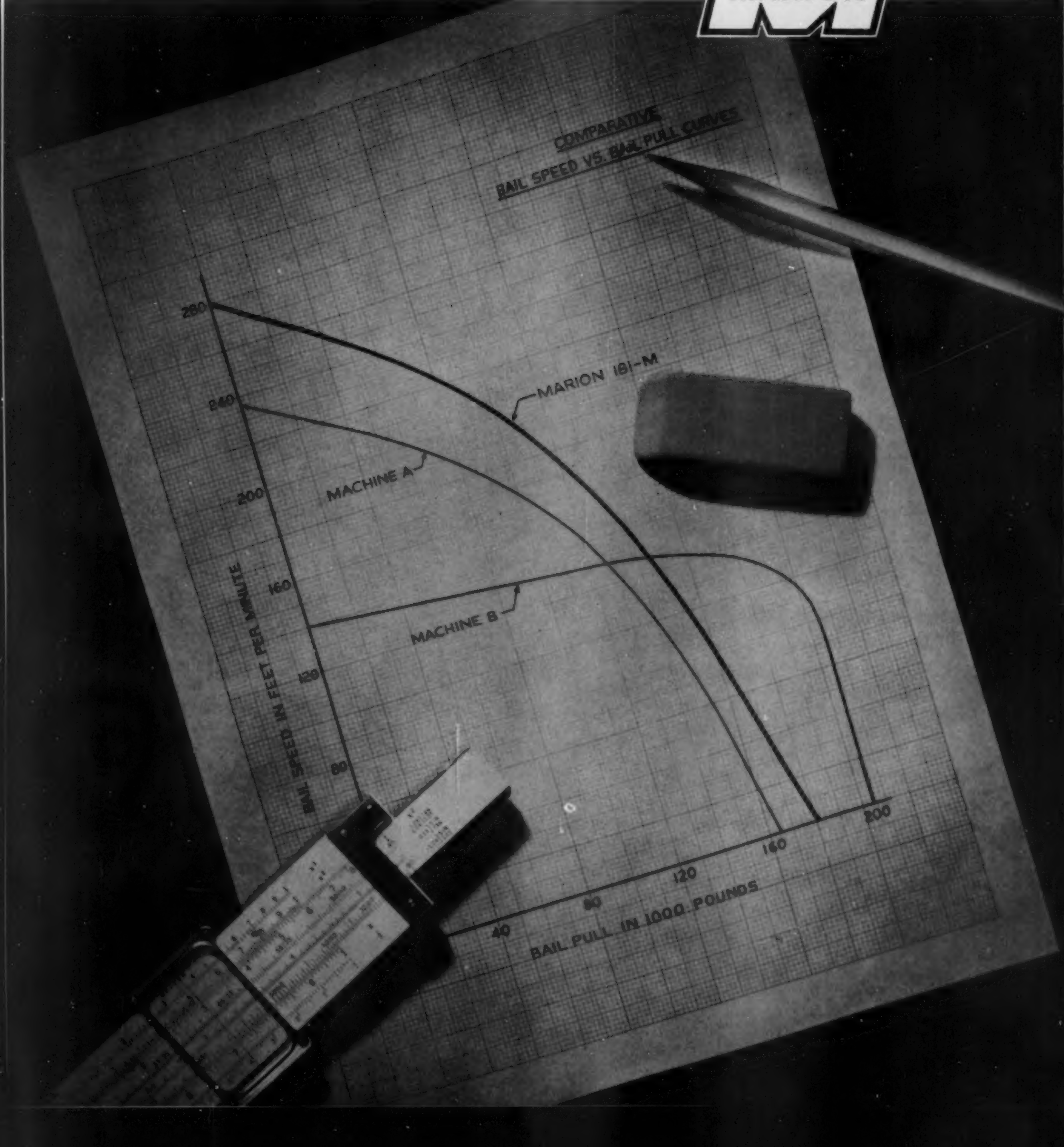

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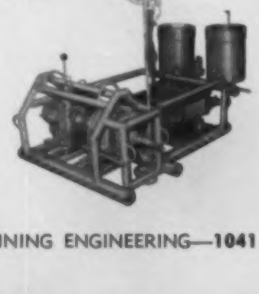

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Correction

On page 876 of the August issue the **Directory of Known Mining Enterprises** (1959, gratis, 1960) was listed under **Missouri** in the groups of **State Publications.** It should have been listed under **Montana,** which was dropped out. This bulletin, which covers mining enterprises in Montana, may be obtained from the Bureau of Mines and Geology, Room 203-B, Main Hall, Montana School of Mines, Butte, Mont.

• • •

Geophysical Surveys in Mining, Hydrological and Engineering Projects, *European Assn. of Exploration Geophysicists,* 624 S. Cheyenne, Tulsa, Okla., 280 pp., $3, 1958.—This volume is devoted to case histories of mining exploration projects, water investigations, and civil engineering problems. Of the 21 papers presented, 13 are concerned with mining problems from many countries, covering a wide variety of geological conditions. Three papers discuss the important problem of water investigations and the use of electrical techniques; the remainder deal with civil engineering problems, mainly dam sites.

Case Histories on Statistical Methods for Quality Control, Series II (Regression, Correlation and Association) *American Iron and Steel Institute,* available from American Society for Quality Control, 161 W. Wisconsin Ave., Milwaukee 3, Wisc., 108 pp., $1, 1960.—Case histories in this volume are oriented with emphasis on methods rather than on specific areas of application. This is the second of a series of such books. The general problem attacked is now to increase open hearth production with existing facilities utilizing an unique approach to the study of statistical methods. The relationship between these methods is examined.

Mining Year Book 1960 compiled by Walter E. Skinner, *Walter E. Skinner and Financial Times,* 20 Copthall Ave., London E.C. 2, England, 824 pp., $7, 1960.—This annual reference work lists the principal world mining and metal companies, and gives complete and up-to-date particulars about them. A section on mining engineers and mine managers gives 1230 names and addresses and the International Buyers' Guide contains over 2000 selected headings and entries.

Mining Directory of Minnesota, 1960, by Henry H. Wade and Mildred R. Alm, *Mines Experiment Station,* University of Minnesota, Minneapolis, 288 pp., $1, 1960.—A list of all operating companies and major holding organizations identified with Minnesota iron ranges, together with officials, subsidiary and affiliated companies, plus pertinent information, general statistics, and maps.

MacRae's Blue Book, 1960 edition, compiled by *MacRae's Blue Book Co.,* 18 E. Huron St., Chicago 11, Ill., 3576 pp., $20, 1960.—Annual directory containing company listings, product directory, and in the separately bound, 700 pp. section, addresses and trade names.

Search for the Past by James R. Beerbower, *Prentice-Hall Inc.,* 533 pp., $7.50, 1960.—An introduction to paleontology which answers some general questions about the subject: What is it? What do paleontologists do? What are the conclusions of paleontology? It emphasizes methods and proncíles and presents a synthesis of the geologic and biologis aspects. The authors approach is simple and he stresses the evolutionary, developmental, and paleoecologic viewpoints. There is a lavish use of visual material and glossaries for each of the important group of fossil animals. • • •

ASTM Standards on Coal and Coke, *American Soc. for Testing Materials,* 1916 Race St., Philadelphia 3, Pa., 144 pp., $3, 1959.—This publication brings together in convenient form the various ASTM methods of testing, definitions, and specifications for coal and coke, and the standard specifications for the classification of coal according to rank and grade. • • •

The Role of the Consulting Engineer in Federal Public Works Projects, *National Soc. of Professional Engineers,* 2029 K St. N.W., Washington 6, D.C., 144 pp., $3, 1960.—This report, prepared by the National Soc.'s Functional Section for Consulting Engineers in Private Practice, gives the results of a survey of 1464 engineering service contracts with 17 different government agencies and bureaus. The report shows that average fees charged by private engineering consultants on government projects are considerably lower than widely publicized cost figures. • • •

Proceedings of the Symposium on Shaft Sinking and Tunnelling, 1959, *The Institution of Mining Engineers,* 3 Grosvenor Cresent, London S.W.1, England, 500 pp., $8.68 (£3 2s 0d), 1960.—This volume contains papers presented at the Symposium held in London during July 1959, together with their respective discussions and a comprehensive index. Authors of international repute from 14 countries presented 25 papers, recording a vast experience of various methods designed to meet widely differing geological conditions. • • •

Annotated Bibliography of Papers Related to the Geology of Idaho, 1941-1959 by Clyde P. Ross, Pamphlet No. 119, *Idaho Bureau of Mines and Geology,* Moscow, Idaho, 224 pp., $1.25, 1959.—This volume contains an abstract of each item listed, whether a complete report, an abstract, or some other form of record of work done.

Gold vs. Grain by Robert L. Kelley, *The Arthur H. Clark Co.,* Glendale 4, Calif., 324 pp., $9.50, 1960.—This book tells the fascinating story of a period in California mining history

(Continued on page 1048)

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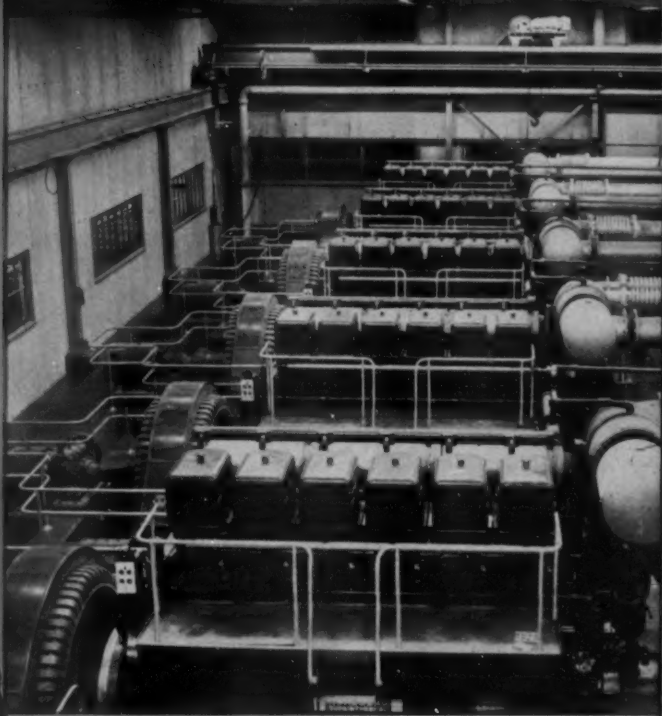

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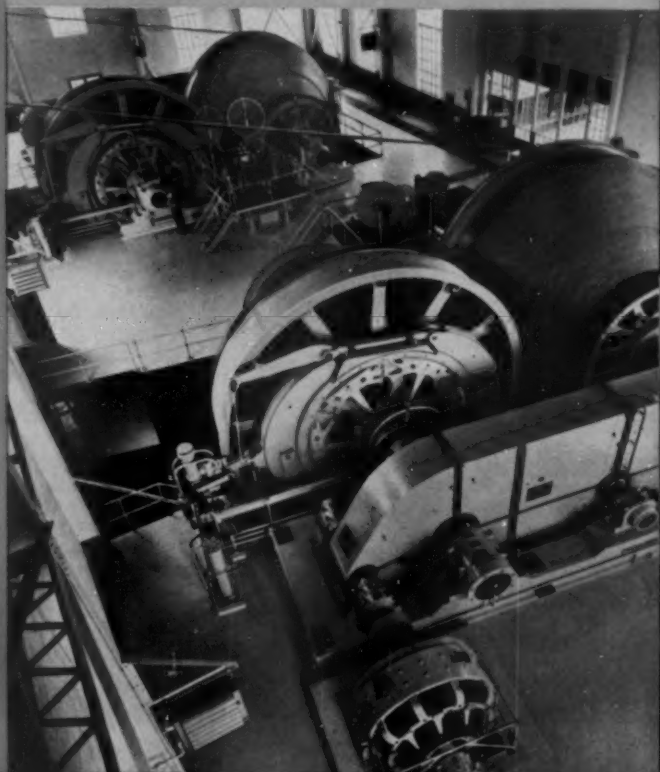

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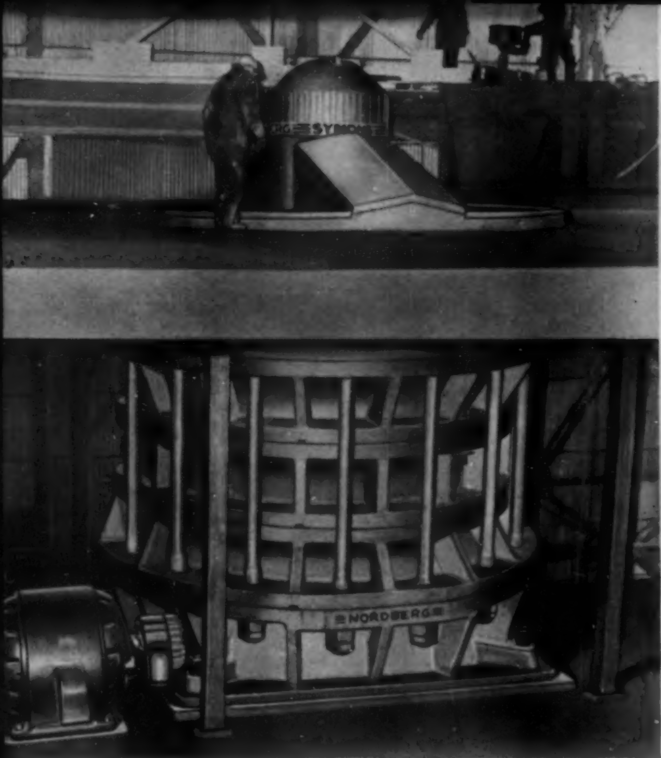

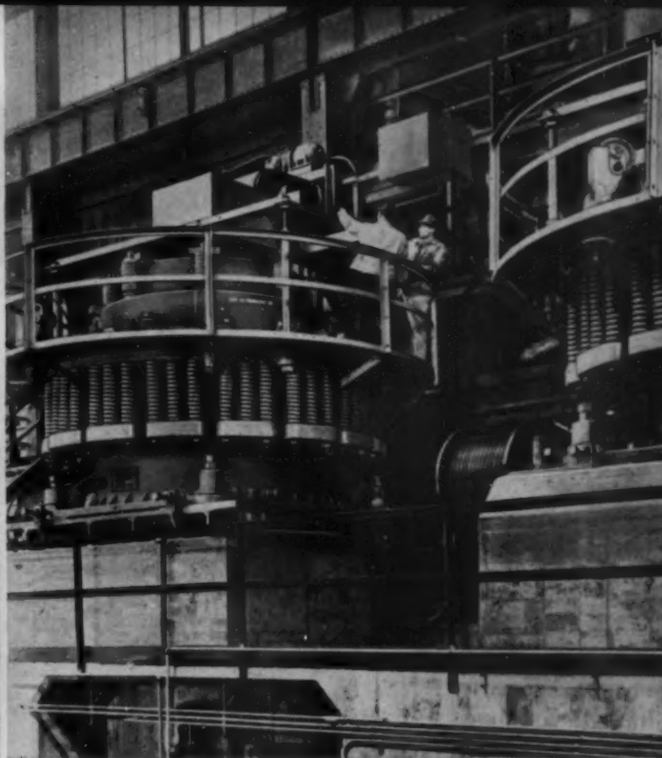

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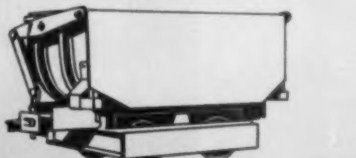

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BOOKS

Continued from page 1045

beginning in the early 1850's when hydraulicking was first introduced to the final control of the problem caused by this process in the '90's. It tells of the long and bitter opposition of the valley residents and farmers, to the damage caused by flood carried hydraulic mining debris. The period of severe conflict in the decades of the '70s and '80's receive the main emphasis. There is also a chapter on the aftermath and reconstruction to 1956. • • •

Minerals Yearbook 1959, USBM, Vol. I, Metals and Minerals (except Fuels), *U.S. Government Printing Office*, Superintendent of Documents, Washington 25, D.C., 1417 pp., $4, 1959.—Contains a wealth of facts on mineral production, uses, distribution, imports and exports, employment and injuries as well as summaries of important statistical information, discussions of significant technological developments, detailed statistics on world mineral production, and accounts of outstanding industrial developments at home and abroad. • • •

Minerals Yearbook 1959, USBM, Vol. II, Fuels, *U.S. Government Printing Office*, Superintendent of Documents, Washington 25, D.C., 491 pp., $2.25, 1959. • • •

Minerals Yearbook 1959, USBM, Vol. III, Area Reports, *U.S. Government Printing Office*, Superintendent of Documents, Washington 25, D.C., 1073 pp., $3.75, 1959.—A detailed review of mineral activities in the 50 states and the offshore areas of the U.S. • • •

STATE PUBLICATIONS

Georgia

Dept. of Mines, Mining and Geology
State Division of Conservation
19 Hunter Street, S.W., Atlanta 3, Ga.

The Geology and Mineralogy of Graves Mount, Georgia, Bulletin No. 66, $1, 1959.

Source and Quality of Ground Water in Southwestern Georgia, Information Circular 18, 50¢, 1960.

Illinois

Dept. of Mines and Minerals
Room 112 New State Office Bldg.
400 South Spring Street, Springfield, Ill.

Coal Report 1959, gratis

Indiana

Publications Section Geological Survey
Indiana University, Bloomington, Ind.

Gravels of Indiana, Report of Progress No. 17, $1.00 plus 10¢ mailing charge, 1960.

(Continued on page 1056)

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How to convey hot bulk materials with initial temperatures up to 1900°

IN ACTION
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American Mining
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Rex Apron Feeders,
Vibrating Screens and Grizzly Feeders

Visit Rex Booth Nos. 601 and 603, the American Mining Congress Show, and find out how Rex Outboard Roller Steel Pan Conveyors provide a practical solution to many unusual conveyor problems.

Here are two of the ways improved Rex design gets right to the heart of the heat problem:

1. Chain and rollers are isolated from maximum temperature heat zone.
2. Carbon steel pans, with large pan surfaces, provide maximum heat transfer.

Long wear life, easy maintenance—Ruggedly built for extra stamina, Rex Outboard Roller Steel Pan Conveyors are known for their long, trouble-free service and low maintenance cost. Wear is confined to heavy outboard rollers; square through rods connecting the chains assure rigidity, equal load distribution; and outboard roller design permits easy servicing *without* disassembly of chain or conveyor.

Preferred throughout industry—Deep pan construction, shown above, is ideally suited for use in a wide range of heat processing applications; for example: calcining, sintering, briquetting, beneficiating and nodulizing. This style is available in a wide range of sizes.

Also on display in Rex Booth Nos. 601 and 603: a full line of conveyor components including chains, sprockets, buckets and self-aligning roller bearings.

For information on how Rex Apron Feeders, Apron and Pan Conveyors and components can help you cut production costs, write CHAIN Belt Company, 4794 W. Greenfield Ave., Milwaukee 1, Wis. In Canada: CHAIN Belt (Canada) Ltd., 1181 Sheppard Ave. East, Toronto.

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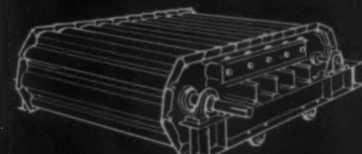
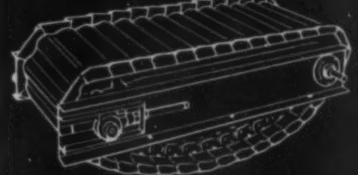
OUTBOARD ROLLER
STEEL PAN CONVEYOR

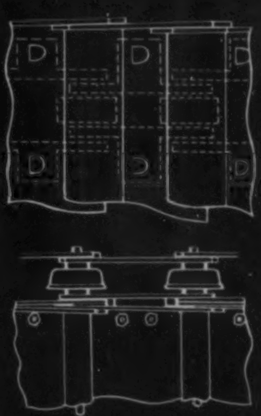
Types For EVERY Service



Rex 2342-K21 Heavy-Duty Feeder for primary or secundary application.



Rex 531-K17 Light-Duty Apron Feeder, used under hoppers and bins to regulate material flow.



Style A aprons with Type K or A chain attachments furnished as machinery parts for many applications.

TRAYLOR-PIONEERED AND TRAYLOR-PERFECTED

efficiency built into this rotary kiln

Traylor engineers were called on to design this modern 450′ kiln for Canada Cement Co. This kiln features many Traylor pioneered developments which decrease down time and increase production. It has full-thrust roller mechanism and roller supports tied together so that a rigid mounting is obtained insuring better kiln operation. The riding ring is mounted on machined steel pads which hold the ring securely in place but allow full-floating action, continuous operation and low maintenance.

Write outlining your kiln requirements for recommendations by Traylor engineers . . . and for Bulletin No. 1115.

This kiln at the Canada Cement Company in Montreal is 12′ x 450′. Seven roller supports keep its 450 foot length in steady easy alignment.

Traylor

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TKA-11

MANUFACTURERS NEWS

NEWS / EQUIPMENT / CATALOGS

Ore Trucks

Forty-ton ore movers measuring 30 ft long, 13 ft high, and 12 ft wide have been introduced to the mining industry by the *KW-Dart Truck Co.* Model 40SL is reportedly the largest-capacity two-axle dump truck

to be put into service. The trucks are powered by a V-12 diesel engine coupled with a four-speed transmission-converter. **Circle No. 1.**

Portable Foam Generator

For fighting mine fires, the *Safety Development Corp.* has devised a portable foam generator equipped with pleated nylon netting, nozzles and other accessories, and a proportioning pump assembly to mix a special foaming agent with water. The equipment is capable of generating 12,000 cfm of foam and driving it 2000 ft from the machine. U.S. Bureau of Mines experiments in fighting mine fires with foam was discussed in the September 1960 issue of MINING ENGINEERING. **Circle No. 2.**

Portable Guniting Equipment

To bring an inexpensive concreting process underground, *Ridley & Co.* has developed a compact guniting plant composed of a paddle-type mixer, an elevator, a concrete gun, and a 100-ft long guniting hose with nozzle. It is reported capable of emplacing concrete at the rate of six

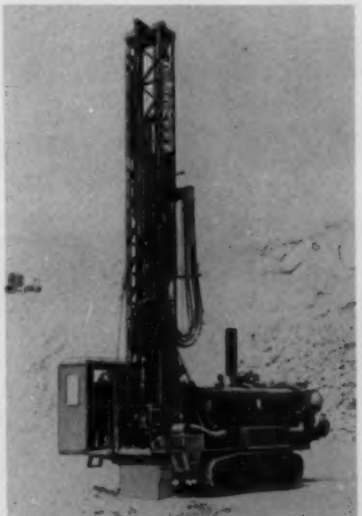
to twelve tph for reinforcing drifts, shafts, stopes and pillars. Designated as Model C-3 UG, the unit is 6-ft high, can be transported on a mine car, skids, or tires, and can be disassembled to pass through narrow openings and re-assembled at the job site. The rig uses air motors powered by mine ail lines. **Circle No. 3.**

Freeze-Proofing Compound

Hardy Frez-Pruf Compound, manufactured by the *Hardy Salt Co.*, has been developed to prevent coal, ore, aggregate and similar materials from freezing while in transit or storage. The new compound contains a phosphate additive which adheres to metal surfaces to provide protection against oxidation and electrochemical corrosion. **Circle No. 4.**

Blasthole Drilling Rig

Model C66 Rotadrill, mounting all equipment necessary for drilling holes to required depths in quarry and rock removal operations on a single self-propelled crawler, has been introduced by *Schramm Corp.* Designed for one-man operation, the rig features a 600 cfm air compressor mounted on the crawler as well as a rack for holding extra drill pipe. **Circle No. 5.**



A-N Blasting Primers

Three compact, easy-to-handle primers for safe, economical initiation of low grade ammonium nitrates and other blasting agents are now available from *Austin Powder Co.* Designated by color and known as Austin Red Cap, Blue Cap, and Black Cap, the primers are reported to be unaffected by water and completely insensitive to shock and abrasion with rifle impact sensitivity of zero. The primers weigh 13 oz but are said to be comparable to 30-lb dynamite primers. Their speed exceeds 22,000 fps, and they are furnished with a central channel to permit fast threading of detonating fuse through their entire length. **Circle No. 6.**

Mine Track Dolly

The Nolan Co. has announced the availability of a many-purpose track dolly for assisting easy transportation of rails, supplies, tools, etc., in underground mines. The

two-wheel unit is built of tubular high carbon steel with a deck of heavy mesh-expanded steel. Operator's handle is placed to assure correct balance and full control of heavy loads. **Circle No. 7.**

Coal Dryer

Pritts Construction Co. has designed a coal dryer utilizing coal dust, normally carried off as waste in conventional dryers, to generate the required heat more efficiently and economically. Capable of handling lump sizes to zero or slack, the dryer can process up to 200 tph. The coal is kept in suspension long enough for heated air to evaporate all moisture and also to cool the coal so that the finished product is well below critical temperature, thus eliminating expensive coal fires. **Circle No. 8.**

Pneumatic Vibrator

To keep moist material moving through all types of piping arrangements, the *National Air Vibrator Co.* has designed a pneumatic impacting vibrator for pipe. The BH-2 Air Vibrator utilizes a timed piston im-

pact to dislodge powdered coal, carbon black, ores and fly ash. Its one-piece design eliminates body assembly bolts and reputedly decreases vibrator maintenance downtime. **Circle No. 9.**

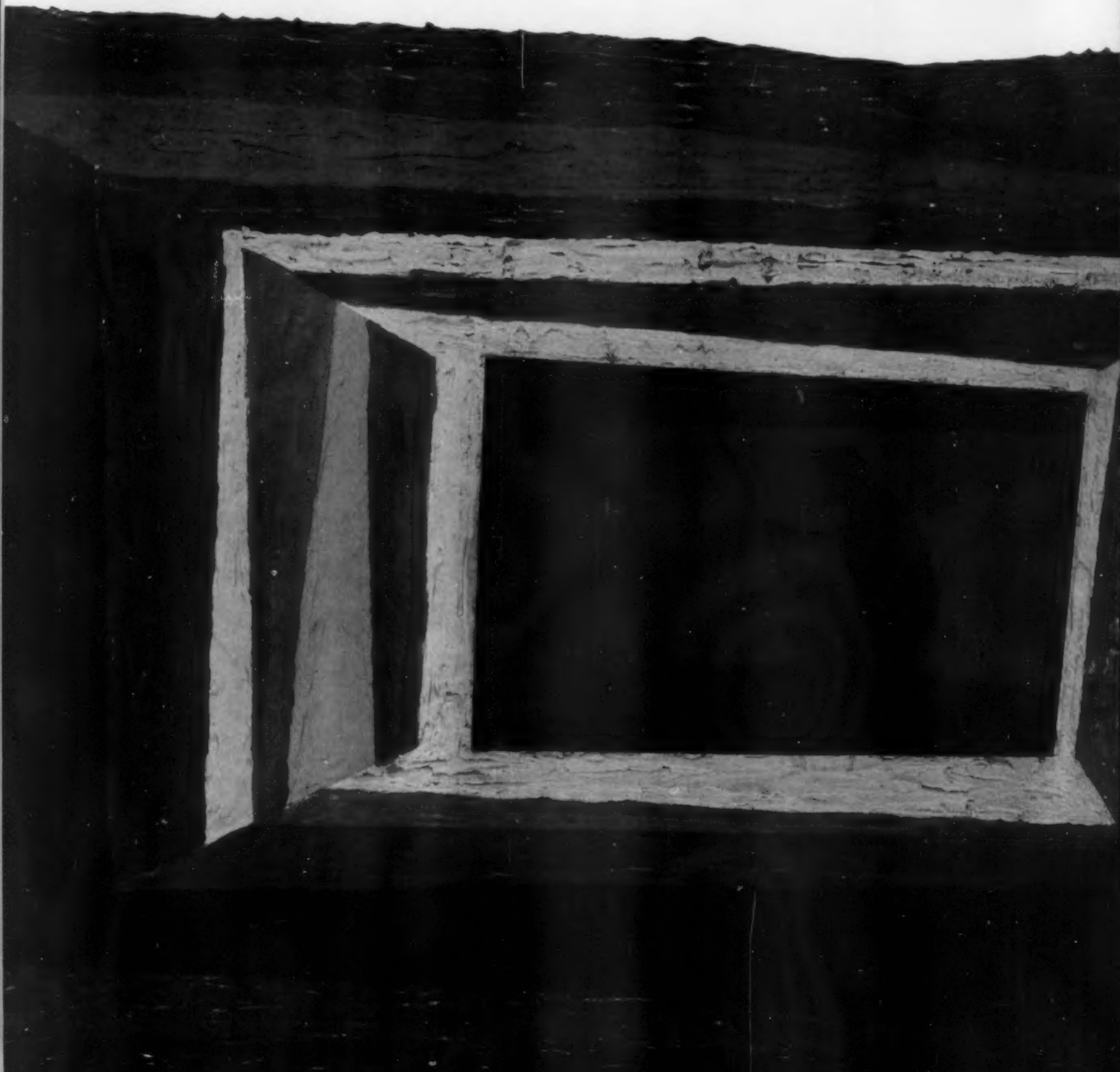
THIS IS MSA: Fire Fighting Equipment • Rock Dusting and Dust Collecting • Illumination • Electronic Communication and Control Respiratory Protection • Artificial Respiration Equipment • Personal Protective Wear • First Aid Equipment • Permanent and Portable Instruments

Prevention is the best control for mine fires . . . but, if a fire starts, immediate use of on-the-spot equipment keeps it under control. Then, major fire fighting equipment can be brought up and completely extinguish the fire. MSA has the products that give you this kind of fire protection.

M-S-A® Dry Chemical is a specially prepared sodium bicarbonate for instant mine fire control. Available in 60-pound bags, it can be stored at vital fire control locations. Should fire occur, Dry Chemical can be spread immediately by M-S-A® Rock Dust Distributors, shovel or, even by hand. It plugs the crucial time gap until large capacity fire trucks arrive. M-S-A® Fire Trucks, available in various sizes, provide the capacity needed to extinguish fires.

Call your MSA representative for additional information. Or write for helpful literature. Mine Safety Appliances Company, 201 North Braddock Avenue, Pittsburgh 8, Pennsylvania. In Canada: Mine Safety Appliances Company of Canada Ltd., 500 MacPherson Avenue, Toronto 4, Ontario.

MSA®



(21) LIQUID CYCLONE CLASSIFIERS: *Dorr-Oliver Inc.* has revised and reissued its bulletin describing rubber-lined DorrClone liquid cyclone classifiers. In this eight-page bulletin No. 2503, a description of Siphontrol underflow control has been added. Siphontrol, which may be supplied as an accessory, maintains a reasonably constant underflow density automatically without instrumentation over a full range of feed variations.

(22) BELT CONVEYOR IDLERS: "Deep Trough Belt Conveyor Idlers," is the title of a new eight-page book, No. 2716A, supplementing Book 2716 recently issued by *Link-Belt Co.* The book contains selection data on 60 new 35° deep trough idlers and 24 new additions to the line of 45° idlers. It also contains capacity ratings and design information for the 35° idlers.

(23) CRUSHERS: The story of the Gyradisc crusher for use in the production of large tonnages of extremely fine products is told in a new four-page, two-color bulletin released by *Nordberg Mfg. Co.* It describes the revolutionary method of comminution by the Gyradisc, a process of alternately impacting and releasing a thick mass of material, and the unique feed arrangement to assure thorough mixing. Cross-sectional and dimensional drawings illustrate the operation and function of the various components.

(24) DRAGSCRAPER: A new 20-page catalog issued by *Sauerman Bros. Inc.* describes and illustrates DragScraper storage and reclamation. Installation photographs and layout drawings show the machines handling chemicals, ores, sand, and other bulk materials. Parts 1 and 2 of Catalog *E* cover outdoor and indoor material handling. Part 3 discusses the various components of the machines including such items as buckets, blocks, and hoists.

FREE LITERATURE

(25) ROTARY TABLE FEEDERS: The conveyor division, *Chain Belt Co.*, has issued an eight-page bulletin, No. 6093, describing its standard Rex rotary table feeders. The leaflet contains diagrams, dimensions, and specifications covering the three standard feeders available. Each type is designed especially for use in such areas as mining and foundry work. Also featured is an easy-to-read selection guide to aid in selecting the right model to meet specific needs.

(26) ORE WASHING EQUIPMENT: *Eagle Iron Works* has recently issued bulletin 760 describing washing and dewatering equipment for ore and non-metallic minerals. Equipment described includes screw washers, log washers, and water scalping-classifying tanks and they are pictured on the job at iron, phosphate, and other mines.

(27) SAFETY BLOCK: Leaflet 111 E from *Machinery Center* describes and illustrates the Sala safety block which was developed in cooperation with one of the largest mining companies in Sweden. It provides freedom of movement with absolute safety. Two types are shown with illustrations of where each can best be used.

(28) DIAMOND DRILLING EQUIPMENT: The mining division of *Christensen Diamond Products* has issued a catalog describing its bits, core barrels, reaming shells, casing shoes, casing bit, and reamers. It contains selection information, descriptions, specification tables, and illustrations showing the equipment in use at job sites. A price list is also included.

(29) PROCESS INDUSTRIES EQUIPMENT: Equipment for the process industries is described in a comprehensive new 12-page, two-color bulletin G-3D, from *Fuller Co.* Applications and performance characteristics of the equipment are discussed, operating principles explained, and photographs showing typical installations included.

(30) BELT CONVEYORS: *The Jeffrey Mfg. Co.* has issued four-page bulletin No. 970 describing its wire-rope type belt conveyors for underground service. A line drawing of a typical arrangement is shown, as well as photographs of the conveyors in action at several job sites.

(31) DRILLING EQUIPMENT: A new 12-page brochure, bulletin CDAT-1, issued by *Gardner-Denver Co.* gives data and operating information on their complete line of crawler-mounted drilling equipment. Combinations of the equipment, including drill carriers, drill feeds, and various types and sizes of drills, are graphically illustrated to show the right combinations for any specific drilling application. Construction features, operating features, specifications, and other pertinent details are presented in a series of pictures and diagrams.

(32) CONTRACT RESEARCH: *Battelle Memorial Institute* recently issued the first in a series of illustrated statements on contract research for industry entitled "Procedures of Contract Research for Industry." This booklet serves as a point of departure for the series and describes in a step-by-step manner the relationship between client and research institute, beginning with the preliminary conferences and carrying through to the institute's post-research responsibility and interest. For copies write directly to Publications Office, Battelle Memorial Institute, 505 King Ave., Columbus 1, Ohio.

mail this post card for more information

10

Mining Engineering **29 West 39th St.** **New York 18, N. Y.**

Not good after January 15, 1961

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61	62	63	64						

Students should write direct to manufacturer.

(33) COPPER REFINERY: The latest Kellogram, "New Copper Refining Plant," issued by *The M. W. Kellogg Co.*, describes the award-winning copper refinery which the company constructed for Kennecott Refining Corp. outside of Baltimore. The 16-page colored brochure covers three main areas of the plant—the anode casting, the tank house, and the fine casting facilities. One section deals with special equipment Kellogg designed to cut costs and save time. How three specific construction problems were solved is another highlight.

(34) CRANE: *The Thew Shovel Co.* has issued a 12-page catalog on its recently introduced 60-ton Lorain Moto-Crane Model MC-760. One of the features discussed in the three-color booklet is Lorain's exclusive Power-Set outriggers that can be set up in minutes. They are designed with special curved beams with attached self-adjusting floats that move out and down simultaneously. Each beam is individually hydraulically controlled from the carrier cab. Another feature included is a ten-year warranted Shear-Ball connection, Lorain's ball bearing design which connects the turntable to the carrier. The booklet shows pictures of the new crane in action.

(35) ORGANIC CHEMICALS: *Armour Industrial Chemical Co.* has issued a catalog of its aliphatic organic chemicals. The booklet covers specifications of more than 200 fatty acids and fatty nitrogen derivatives and shows typical applications of each group.

(36) VOLATILE LIQUID PUMPS: A new six-page, three-color bulletin entitled "Layne Volatile Liquid Pumps" has been published by *Layne & Bowler Inc.* It includes cross-section drawings of the standard short-coupled vertical turbine pump and the canned type vertical turbine pump with their uses and applications illustrated.

(37) SPEED REDUCERS: Brochure No. F-2003, containing technical information on shaftmounted geared speed reducers as well as illustrations, feature descriptions, and selection and ordering instructions on the U.S. Shaftmount Syncrogear, has been issued by *U. S. Electrical Motors Inc.* Tables are included showing the service classifications to be applied in determining the types of speed reducers to be used in numerous industrial applications and under various conditions of usage. By using these tables in conjunction with hp rating tables for frame size selection (which are provided for each of three service classifications), it is possible to obtain specific output rpm's in various ranges from 10 to 125 for horsepowers of ¼ to 40. the proper steps to take in selecting speed reducers are detailed with an example to make the instructions clear.

(38) CEMENT LOADING: How centralizing the cement loading facilities at one plant has enabled The Permanente Cement Co. to simplify its bulk handling operations is the subject of a new technical report, pamphlet ER-3241-4, recently issued by *Fuller Co.* The new report describes and illustrates the versatile loading operations employed in Permanente's Long Beach, Calif. plant for the bulk-loading and unloading of railroad cars, ships, barges, and trucks. It also gives operational data on the principal equipment used within the plant.

(39) GENERATOR SETS: An eight-page brochure entitled "GM Diesel Generator Sets for Standby and Continuous Off the Line Power" has recently been issued by *General Motors Diesel Engine Division.* Form 8SA68 contains charts showing technical data on generator sets from 13.5 kw to 260 kw. Other sections of the booklet outline specific sales features, warranty information, and GM's world-wide distributor-dealer organization.

(40) CONVEYING SYSTEMS: *The Day Co.* has issued a 16-page, illustrated bulletin which explains efficiency gains possible with its low-density or high-density conveying systems. Typical arrangements are shown as well as several photographs of conveyor installations.

(41) TRAXCAVATOR: Design and engineering details of the Cat No. 966, largest of its wheel Traxcavator line, are described in a 12-page booklet recently released by *Caterpillar Tractor Co.* Photographs show the machine in action and line drawings illustrate design elements and parts.

(42) REDUCING AND RELIEF VALVE: A catalog sheet from *Atlas Valve Co.* introduces a new pressure reducing and relief valve designed for use in water, oil, air, or gas service to initial pressures of 4000 psi. The illustrated two-color sheet includes valve drawings, capacity charts, valve features, operation, applications, description, and ordering information.

New Films

A new 20-min color and sound film from *Gardner-Denver Co.* presents the basic principles of rotary air drilling and its application in mining, quarrying, and construction. The different procedures of set-up and operation of the equipment are fully detailed. Basic components of the equipment are shown and their function described. Available on free loan from Gardner-Denver Co., Quincy, Ill.

The Modern Prospector, a 16mm black and white sound film produced by the *National Film Board of Canada* shows how prospecting has changed from the old "sourdough" days since the advent of such modern equipment as airplanes, cameras, electromagnetic recording machines, gravity meters, ground current devices, and a score of lessor modern tools. The film can be purchased from International Film Bureau Inc., 57 East Jackson Blvd., Chicago 4, Ill. for $85.

Application of Production Machines, a 20 min color and sound film produced by *Gardner-Denver Co.* presents a visual demonstration of a variety of automatic machines built by its Production Machine Division. Emphasis is placed on increased production at greatly reduced cost. The film shows how fine quality work is attained by the automated process. Available on free loan from Gardner-Denver Co., Quincy, Ill.

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ADVERSE GRADE OUT OF PIT IS 6 TO 10%

—but DW20G averages 4-minute cycles on 1-mile round-trip haul!

This Cat DW20G-456B rig is one of four used by the Vitro Minerals Corp. to strip overburden from uranium ore near Riverton, Wyoming. Notice the adverse grade of 6 to 10% out of the pit. Even under such unfavorable conditions, this unit makes a mile round trip in 4-minute cycles with an 18-yard payload of sand with high clay content—up to 270 yards an hour.

Here is just one of hundreds of examples where the power, speed and stamina built into the DW20G pay off on the job. You can count on it for high, steady production day in and day out.

With 345 horsepower stepping up rimpull 12%, the DW20G travels up to 20% faster than the previous model—even with the greater load capacity (19.5 cu. yd. struck) of the new 456B LOWBOWL Scraper.

Caterpillar SynchroTouch Transmission Control is optional—the operator simply dials the speed he wants. Split-second, touch-and-go response cuts cycle time—brings in more payloads per hour.

Call your Caterpillar Dealer and get the whole story on how the tough, dependable DW20G can step up production and profits on your jobs!

Caterpillar Tractor Co., General Offices, Peoria, Ill., U.S.A.

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HAUL AT LOWEST COST PER CU. YD.

BOOKS

Continued from page 1048

Maine

Robert G. Doyle, State Geologist
Dept. of Economic Development
State Office Bldg., Room 211, Augusta, Maine

Geologic and Aeromagnetic Compilation Map of Northern Maine, black and white paper prints, set of 4, $2.45.

Minnesota

Iron Range Resources and Rehabilitation
624 State Office Bldg., St. Paul, Minn.

The Future of Minnesota Resources 1959, gratis.

South Dakota

William F. Emery, Inspector of Mines
Lead, South Dakota

56th Annual Report of the Inspector of Mines, Fiscal Year 1958, gratis.

ABSTRACTS

In This Issue: *The following abstracts of papers in this issue are reproduced for the convenience of members who wish to maintain a reference card file and for the use of librarians and abstracting services. At the end of each abstract is given the proper permanent reference to the paper for bibliography purposes.*

New Plan for Unity by *Will Mitchell, Jr.*—Progress report of an investigation conducted by the AIME Committee for Inter-Engineering Society Cooperation. It is believed by many engineers that the engineering profession should be unified into an organization similar to the American Bar and American Medical associations. This report outlines the functions of several societies closely associated with the AIME, presents a plan for unity, and summarizes tax regulations to be considered. **Ref. (Mining Engineering, October 1960) p. 1080.**

Stripping Overburden with a Dredge by *John G. Cazort, Jr.*—The aluminum Co. of America utilized a dredge to strip overburden from a new bauxite deposit in Paranam, Surinam. It proved to be the most economical method of stripping at that site. Operations and applications of the dredge are analyzed. **Ref. (Mining Engineering, October 1960) p. 1083.**

Wire Rope Sideframe Belt Conveyors at Ben Creek No. 2 Mine by *E. Morgan Massey*—At this new coal mine the management has installed a wire rope belt conveyor system to meet the conditions of rugged terrain in West Virginia. This system has permitted location of coal crushers, preparation plants, and blending facilities at desirable spots between the mine and railroad loading sites. **Ref. (Mining Engineering, October 1960) p. 1090.**

Wage Incentives in Underground Mining by *Borje O. Saxberg* and *Roger L. Winter*—The authors have conducted a survey of wage incentive plans at underground mining sites. The survey encompasses 48 firms. They discuss views of both management and miners and the advantages and disadvantages of incentive wage systems as applied to the mining industry. **Ref. (Mining Engineering, October 1960) p. 1094.**

Iron Deposits of Wabush Lake, Labrador by *R. D. Macdonald*—The history of exploration and a study of the geology and stratigraphy of the Carol Lake—Wabush Lake area of the Labrador-Ungava Trough is coupled with detailed information of exploration methods used by the Labrador Mining and Exploration Co., since 1949. The iron formation in the Wabush Lake area is considered to be the southern but more highly metamorphosed extension of the iron formation of the Trough. The success of gravimetric surveys at one specific deposit in the area, Wabush No. 3, is detailed. **Ref. (Mining Engineering, October 1960) p. 1098.**

The Mining Industry in Southeast Asia by *D. F. Coolbaugh*—An analysis of the past, present, and future of mineral production in this underdeveloped area of the Free World. Problems of labor, power, transportation, and financing are considered. **Ref. (Mining Engineering, October 1960) p. 1103.**

SME Meeting Papers: *The following abstracts of papers presented at SME meetings are given for your information. Preprints of these papers are not available.*

Recent Developments in the Strategic-Udy Processes by *Murray C. Udy*—The basic development of the Strategic-Udy smelting process is now essentially complete. Test and production type demonstration on both a 100 KVA and a 1000 KVA electric-furnace scale have conclusively demonstrated the amenability of this process to the selective smelting of a wide variety of both high and low grade ores. These ores may be either simple or complex. For high grade iron ores production costs are from $5 to $10 per ton less than for conventional methods; total investment required is from 50 pct to 67 pct less.

The installation of three completely new steel plants based on the Strategic-Udy process located in Quebec, Arizona, and Montana has been announced. These three plants typify the versatility inherent in the Strategic-Udy process. *AIME-ASM Pacific Northwest Metals and Minerals Conference, Portland, Ore., April 1960.*

Recovering Alumina from Ferruginous Bauxite by *Lloyd H. Banning*—Methods for recovering alumina from ferruginous bauxite that have been investigated at the Bureau of Mines Albany Metallurgy Research Center, Albany, Oregon, are: Smelting to produce a leachable slag and pig iron, the Bayer process, and a double-leach process. The most promising results were obtained by the double-leach process: up to 85 pct of the alumina has been recovered from materials containing as much as 16 pct silica. Work is continuing on this method to determine optimum conditions for the various unit operations. *AIME-ASM Pacific Northwest Metals and Minerals Conference, Portland, Ore., April 1960.*

Gypsum Deposits Adjacent to the Great Northern Railway in Central Montana by *T. P. Wollenzien*—Gypsum occurs at five stratigraphic horizons in central Montana: within the Mississippian Kibbey, Otter, and Heath formations, and the Jurassic Piper formation. The gypsum is exposed in cuestas and hog-backs on the west and north flanks of the Little Belt Mountains, on the north flank of the Big Snowy Mountains, and on the south edge of the South Moccasin Mountains.

Gypsum deposits at 13 separate locations were inspected. Only two of the deposits are actively mined at the present time; the remaining prospects are undeveloped. Strippable tonnage is available at three of the prospects; eventually the recovery of gypsum from these beds would have to be conducted from underground. Underground mining would be necessary at the other locations, and is the method of recovery at the two operating mines. *AIME-ASM Pacific Northwest Metals and Minerals Conference, Portland, Ore., April 1960.*

Structural Control of Alpine Mineral Deposits by *Elmar A. Walter*—The Alpine orogen consists of two structually different parts: the Eastern and the Western Alps. The former is bilaterally symmetrical; the latter asymmetric with sedimentary rocks being present only on the north and West. The two halves join in the general area of eastern Switzerland and South Tyrol.

Alpine mineral deposits of fair size occur principally in the Eastern Alps. Only the magnesite deposits of Veitsch and Radenthein in Austria and the mercury mine of Idria in Yugoslavia are of worldwide importance; however, some of the talc, graphite, and asbestos deposits of Austria and Switzerland also yield significant tonnages.

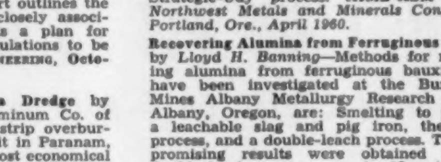
The epigenetic ores are located in two areas, one of which is near ancient transversal fault structures which separate the Eastern from the Western Alps and which also rifted whole sections of the Eastern Alps. The other is in the phyllitic outer zones of the mantled gneiss domes which form the backbone of the Alpine orogen. In both cases high, medium, and low temperature fissure fillings, stockworks, and replacement bodies of the massive and lode variety predominate. Consistent stratigraphic control is limited to siderite and magnesite deposits, which are replacements of Paleozoic carbonates. Most deposits are post-tectonic; that is, Cretaceous or Tertiary. It is assumed that the hydrothermal mineralization around the mantled gneiss domes represents an otherwise nonexistent pegmatite phase. The principal mineral products of these two areas are iron, lead, zinc, copper, silver, tungsten, antimony, mercury, silver, and magnesite.

Evidently syngenetic concentrations are limited to talc, graphite, and perhaps asbestos. They seem to be syntectonic in origin, because they occur as lenses along overthrust planes as well as serpentines along major transversal strike slips. Almost all inner-Alpine coal deposits are post-tectonic and were formed in Tertiary lagoons along the margin of the orogen. The historically significant salt deposits are tectonized irregular masses mostly in Mesozoic carbonates. *AIME-ASM Pacific Northwest Metals and Minerals Conference, Portland, Ore., April 1960.*

Fractures and Craters Produced in Sandstone by High Velocity Projectiles by *John S. Rinehart* and *William C. Maurer*—Yield of oil from a producing well is often enhanced by firing bullets and shaped charges through the well casing into the oil-bearing rock, forming craters and fractures from which oil can flow more readily. The purpose of this investigation has been to develop better understanding of the mechanics of impact crater formation in rock, particularly sandstone, the velocity range being approximately that normally associated with oil-well gun perforators. The bullets were small steel spheres of 3/16, 9/32, and 7/16-in. diam; impact velocities 300 to 7000 fps. The craters have two distinct parts: a cylindrical hole or burrow with diameter the same as that of the impacting sphere, and a wide angle cup comprising most of the volume of the crater. A most significant observation, made for the first time, was that below the base of the cup in one type of sandstone there is a group of similar fractures, not extending to surface, which are spaced uniformly, a few millimeters apart. Each fracture follows roughly the contour of the base of the cup and appears to require a certain threshold impulse to initiate it. These fractures comprise a relatively high fraction of the total newly exposed surface area. *AIME-SPE Annual Fall Meeting (Rock Mechanics Symposium) Denver, October 1960.*

SuperDuty
DIAGONAL DECK
No. 6
CONCENTRATOR
TABLE

DEISTER DIAGONAL DECK OVERSTROM



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Velocity-Log Interpretation: The Effect of Rock Bulk Compressibility by *J. Geertsma*—A theoretical study of acoustic wave velocity in fluid-saturated porous media has been based on Biot's continuum theory. It proved possible to express Biot's deformation constants of a porous system in terms of more directly accessible properties. Moreover, approximate solutions of the basic wave equations were introduced and as a result an expression for the wave velocity in terms of the porosity and the individual contributions of the deformation properties and individual densities of rock matrix, pore fluid, and bulk rock was obtained.

Application of the Biot theory to interpretation of the velocity log in terms of porosity has been only partially successful. This is primarily due to the fact that the rock bulk deformation properties, of which rock bulk compressibility is the most important, are themselves a function of porosity. In addition they are a function of effective stress, type of rock, pore size distribution, composition of grain-cementing material, etc. A relation between these variables and rock bulk compressibility can, at present, be obtained only empirically. Such empirical relations are presented for clean sandstones and for limestones having two distinct types of pores. Striking differences in the velocity behavior for the two limestone pore types are demonstrated.

Some problems related to the effect of shale streaks and natural fractures on the average wave velocity observed by the logging tool as well as the effect of adsorption phenomena on wave velocities measured at atmospheric pressure in the laboratory are discussed. *AIME-SPE Annual Fall Meeting (Rock Mechanics Symposium) Denver, October 1960.*

The Fragmentation of Brittle Media by Concentrated Loadings by *Ralph Simon*—A study is made of the fragmentation of some brittle media by the loadings of wedge-shaped and cone-shaped tools onto the surfaces of effectively semi-infinite specimens. The ratio of the work done in loading with a particular tool to the mean volume of material broken out, averaged over a number of loadings, is found to be constant over the ranges of experimental conditions investigated, in agreement with a result previously obtained in an investigation of the fundamentals of rock drilling. The value of this ratio, termed the *fragmentation strength*, varies with the included angle of the wedge or cone in a different manner for brittle media of different porosities. The mechanisms of energy dissipation in concentrated loadings on brittle media are discussed, particularly with regard to energy requirements for rock drilling. *AIME-SPE Annual Fall Meeting (Rock Mechanics Symposium) Denver, October 1960.*

Stresses Caused by Bit Loading at the Center of the Hole by *J. B. Cheatham, Jr.* and *J. C. Wilhoit, Jr.*—Although an oil well is a long cylindrical hole with an irregular bottom, it appears likely that the nature of the stress concentration at the bottom of the hole can be ascertained by analyzing stresses around a short cylindrical cavity with rounded corners and smooth bottom. Such a cavity is studied primarily because it leads more readily to solving the problem by the use of stress functions. In this paper the stress distribution around a short cylindrical cavity subjected to bit loading, overburden, and drilling fluid pressures is determined by analysis that approximately satisfies the boundary conditions of the problem. From this analytical solution the stresses at the corner of the hole are calculated to be about 35 pct lower than comparable results obtained by photoelastic and relaxation analyses. This difference appears due to the large radius of curvature at the corner of the cavity in the present analysis. Since good agreement is obtained between results of this analysis and the stresses calculated for a similar loading on a semi-infinite elastic solid, it is concluded that bit action in the region near the center of the hole is not appreciably affected by the presence of the side of the hole. *AIME-SPE Annual Fall Meeting (Rock Mechanics Symposium) Denver, October 1960.*

Photoelasticity Study of Rock Bit Tooth Behavior by *Wilbur H. Somerton*—Photoelasticity studies have been made of the stress distribution conditions within a rock bit tooth and within the contacted medium. Conventional two-dimensional photoelasticity methods have been used to simulate single tooth behavior. Contactors of various geometries made of photoelastic material have been used to load the photoelastic contacted medium vertically, horizontally, and at inclined directions. Fringes, which give the magnitude of the difference between principal stresses, and isoclinics, which give the directions of principal stresses, are determined for both the contractor and the contracted medium. From these data, stress trajectories and maximum shear trajectories are constructed. Wherever possible, corresponding analytical solutions have also been presented.

To test the validity of appyling photoelastic results to a porous and heterogeneous medium such as rock, photo-stress techniques have been used. Slabs of three types of sandstone have been stressed under conditions identical to those used in photoelastic studies, and no differences in the stress patterns have been observed. *AIME-SPE Annual Fall Meeting (Rock Mechanics Symposium) Denver, October 1960.*

Geologic Aspects of Fractured Reservoirs by *Peter C. Badgley, William C. Pentilla,* and *James K. Trimble*—A number of fractured reservoir fields are briefly described in the literature, but very little scientific attention has been focused on the discovery of new fracture reservoir reserves. Consequently interest in this subject has been erratic, depending on occasional chance discoveries which were largely incidental to drilling for more conventional objectives. Yet fracture reservoir fields probably represent a major unexploited source of new oil.

Although seismic and geochemical prospecting for new fractured reservoirs has some future potential, their discovery will depend largely on mapping and interpretation of surface fracture patterns and on adequate logging and testing procedures after well locations have been selected. Formations susceptible to fracturing are present in nearly every petroleum basin, but certain portions of each basin, such as hinge belts, monoclines, and mobile rims, are usually more favorable for fracture generation.

The significance and interpretation of fracture patterns depends entirely on full understanding of their mechanical origin and time of generation. A study of existing fields indicates that there are three main types of reservoirs based on the time of fracture generation relative to the time of sediment lithification and the time of oil generation and initial migration.

This paper discusses the origin, time of generation, geological setting and discovery of each type of fractured reservoir, based on a review of the literature and new field information gathered by the writers. *AIME-SPE Annual Fall Meeting (Rock Mechanics Symposium) Denver, October 1960.*

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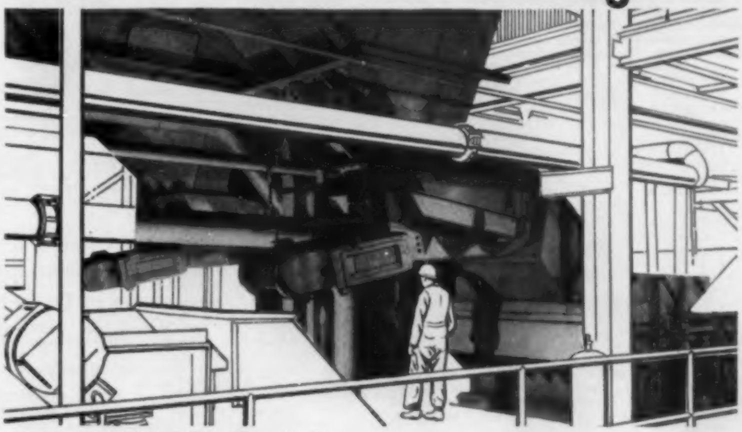

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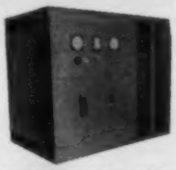

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NOTICE—SME PREPRINT AVAILABILITY, 1960 ANNUAL MEETING

The following list of papers (from the 1960 New York Annual Meeting) will be available until Jan. 1, 1961. Coupons received with the 1960 dues bills and those distributed at the 1960 Annual Meeting will also expire on this date. Purchased coupons books will be honored on any future date. A new listing of available papers will appear in a forthcoming issue. It will include additional papers presented at the 1960 Annual Meeting (New York) and at other SME meetings throughout the year. **Preprints may be obtained (upon presentation of properly filled out coupon) from SME Headquarters, 29 W. 39th St., New York 18, N. Y.** Coupon books may be obtained from SME for $5 a book (10 coupons) for members or $10 a book for nonmembers. Each coupon entitles the purchaser to one preprint.

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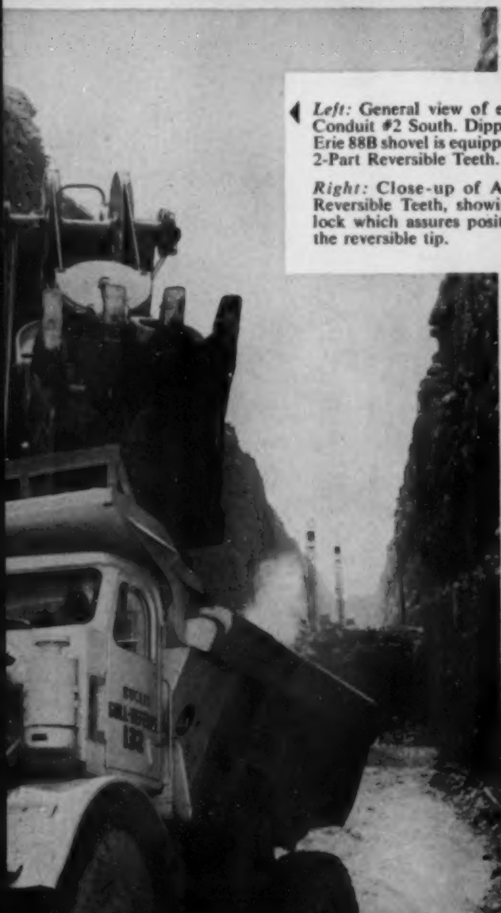
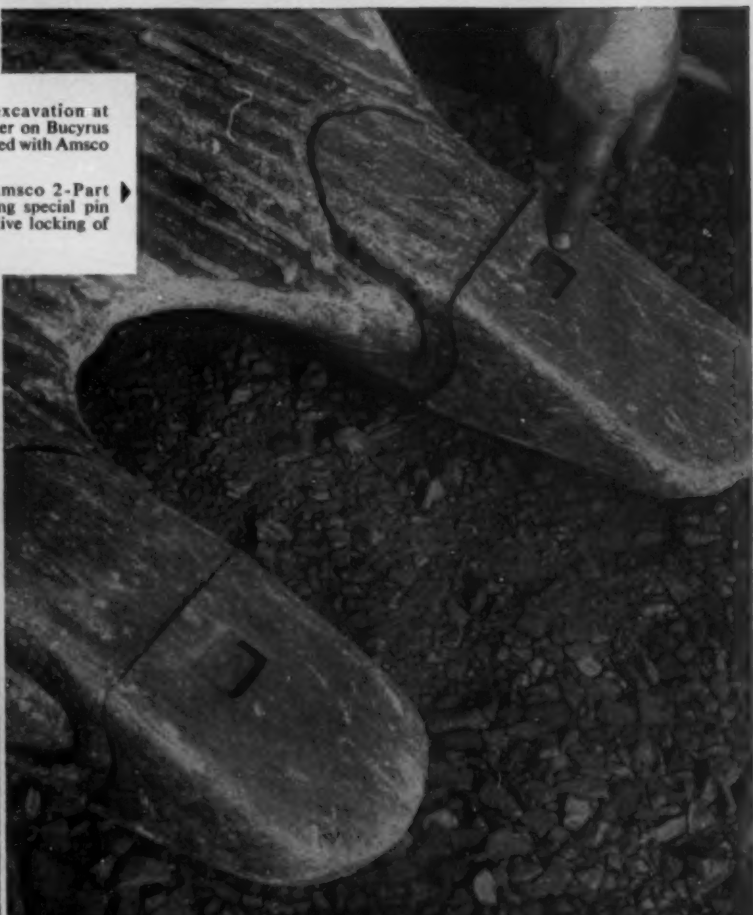
Left: Close-up of Amsco Chute Plates used on each discharge Hi-G screen.

Right: General view of Hi-G screen in screen house of large New England quarry.





Left: General view of excavation at Conduit #2 South. Dipper on Bucyrus Erie 88B shovel is equipped with Amsco 2-Part Reversible Teeth.

Right: Close-up of Amsco 2-Part Reversible Teeth, showing special pin lock which assures positive locking of the reversible tip.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Nickel Matte in Production at Thompson

International Nickel Co. of Canada Ltd. has begun production of the first nickel matte from its smelter at the Thompson mine in Manitoba. One of three electric furnaces has begun production and the others are expected to come in by year's end. The matte will be stockpiled pending the completion of Inco's refinery some time in January.

Steel vs. Aluminum—New Developments

Increased competition by the aluminum industry in traditional tin plate markets has led to the steel industry development of a new thin tin plated steel. The product, designated Ferrolite by its developer, U.S. Steel Corp., is just about half as thick as the common tin plate used for can making and is far more economical in price. The new tin plate is already available in commercial quantities. The aluminum industry's drive to entrench itself still further as a supplier of metal for can making has brought forth another new development. Aluminum Co. of America and United Shoe Machinery Corp. have developed an aluminum zip-top can that can be opened with a pull of a built-in finger tab. Some industry spokesmen believe the development can eliminate the can opener and open new markets for cans in vending machines, etc. So far output of the cans remains experimental.

President Employs Pocket Veto on Small Mines Lead-Zinc Bill

Subsidiary legislation that would provide payments to lead-zinc producers on the first 2000 tons of production of each metal was cleared by the House and Senate but was terminated by presidential pocket veto for this session. Reaffirming confidence in the lead-zinc quota system. President Eisenhower spelled out reasons for his rejection of the measure, in part citing possible price drops through the additional output the bill would encourage, the complication of existing controls of production and demand, and the possibility that producers of other minerals would demand equal treatment to the detriment of technological improvement of the industry . . . . other Congressional measures introduced to provide a sliding scale of import duties on lead and zinc were not brought up for vote before Congress adjourned.

Sinking Development Shaft at Safford

Kennecott Copper Corp. is taking bids for the sinking of a two-compartment development shaft on its copper property at Safford, Ariz. After driving the shaft to the 800-ft level, the company will cross cut to explore the potential of ore outlined by surface drilling. The property is still in the development stage and no production has begun.

Vitro Receives OME Loan for Beryllium Deposit

Vitro Minerals Corp. has secured an exploration loan agreement from the Office of Minerals Exploration of the Interior Department for exploration of its new beryllium ore property in the Topaz Mountain area of Juab County, Utah. The loan is OME's first under a change of regulations making exploration for beryllium minerals other than beryl eligible for government assistance.

Quebec Cartier Project Near Completion

The huge iron ore project of Quebec Cartier Mining Co. in northern Qubec will begin production of a concentrate grading 65 pct Fe this fall, with first shipments beginning early in 1961. From an open pit mine at Lac Jeannine, the company, a wholly owned subsidiary of U.S. Steel Corp., will produce at the rate of some 60,000 tpd. Future output from the project may total as much as 20 million tons yearly. Reserves are estimated at 300 million tons, and the company is investigating the development potentials of two more northerly ore deposits at Mt. Reed and Mt. Wright.

Foreign Aluminum News

An alumina production facility in Greece with annual capacity of 100,000 tons is the aim of a new agreement by the Athens government, French companies Pechiney and Compadex, the Greek Industrial Development Corp., and the Niarchos group . . . . Japan's production of the light metal continues its rapid growth. Output in 1950 was just 27,000 tons; production in 1959 rose to more than 110,000 tons and output in the first seven months of this year was 27 pct higher than in the like period last year . . . . Nations of the European Common Market recently established a 15 pct ad valorem tariff as the ultimate duty in imports of semi-fabricated aluminum shapes. The duty is to come into effect over the next ten to thirteen years . . . . As a result of the increased Common Market tariff limit, spokesmen of the domestic aluminum industry have urged the rapid establishment of U. S. light metal plants in the member nations of the European Common Market.

Per-Man Coal Output At New High

USBM reports bituminous coal miners in 1959 produced an average of 12 tpd per man—a new record. The output was six-fold higher than per man output in any other nation and bested the 1958 U.S. total by about 1 tpd. Increased mechanization was credited with the biggest share of the production upstep.

U.S. Bauxite Output Biggest Since War, New Import Record

Second quarter output of bauxite in the U.S. soared 48 pct over first quarter production for the highest output since World War II.—710,000 long dry tons—reported USBM. Imports also rose by 15 pct, attaining the biggest tonnage yet recorded—2.3 million long tons.

American-Mexican Firms Awarded Iron Concession in Mexico

Nahuatl, an iron concession in the state of Colima, Mexico, has been awarded to the combine of the American firm Colima Mines Inc. and Mexican Company Minera Ducro S. A., under a new Mexican mining code. Terms of the new concession require that the ore be consumed in Mexico.

Brass Company Changes Name

Effective October 3rd American Brass Co. changes its name to Anaconda American Brass Co. The company, a wholly owned subsidiary of the Anaconda Co., will continue to be headquartered in Waterbury, Conn. Operation policies will be unaffected, a company official said.

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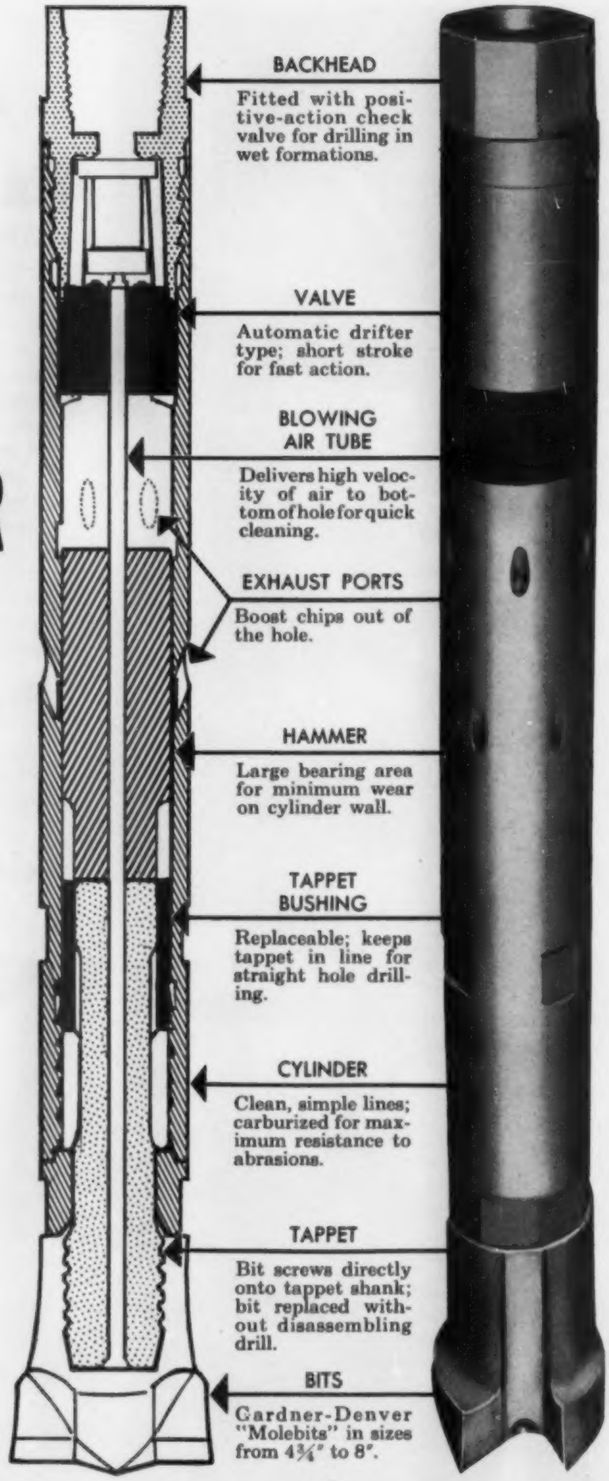

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Gillen used to blast through. Then they changed to a Caterpillar D9 Series E Tractor with a No. 9 Ripper. Production shot up 35%. Cost savings are estimated to be *60%!*

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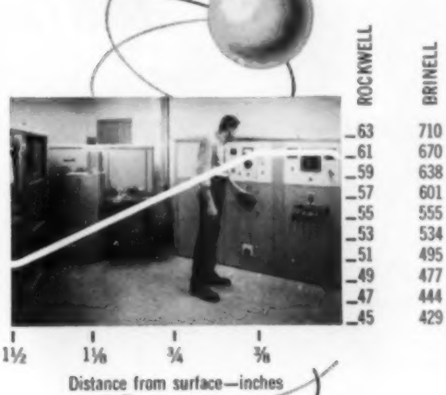

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PLANT	TPD	FEED		% Zn			% RECOVERY	GRIND				
		Gangue	Sulfides	Feed	Conc.	Tails			$CuSO_4$	NaAF	A-211	ABC
A	2000	Limestone, dolomite, chert	ZnS, up to 5% FeS_2, traces PbS	4.0	60.0	0.25	94.2	18.8% + 65 Mesh 32.5% + 100 Mesh 46.8% − 200 Mesh	0.35		0.08	0.10
B	2000	Limestone, dolomite, chert, rare calcite	ZnS, traces of FeS_2	5.5 to 5.75	63.5	0.10	98.4	35.5% + 65 Mesh 48.7% + 100 Mesh 35.7% − 200 Mesh	0.44		0.07	
C	5400 total, 1790 flot.	Dolomite, chert	ZnS, traces of FeS_2 (0.5% Fe)	Flot. 8.08 HMS 3.45	61.95	0.22	96.7 (flot.)	30.9% + 65 Mesh 40.8% + 100 Mesh 41.5% − 200 Mesh	0.860*	0.092*		
D	1550	Dolomite, chert	ZnS, traces of FeS_2	4.59	64.0	0.21	95.7	42.5% + 65 Mesh 53.0% + 100 Mesh 25.5% − 200 Mesh	0.40	0.067		
E	2500	Dolomitic limestone	ZnS, traces of FeS_2	6.4	59.0	0.75	89.5	18% + 100 Mesh 60% − 200 Mesh	1.0		0.17	

*Reagents on basis flot. feed

Here are operating results from five large U.S. zinc mills showing how reagent combinations based on SODIUM AEROFLOAT or AEROFLOAT 211 Promoters produce maximum recovery in a high-grade concentrate.

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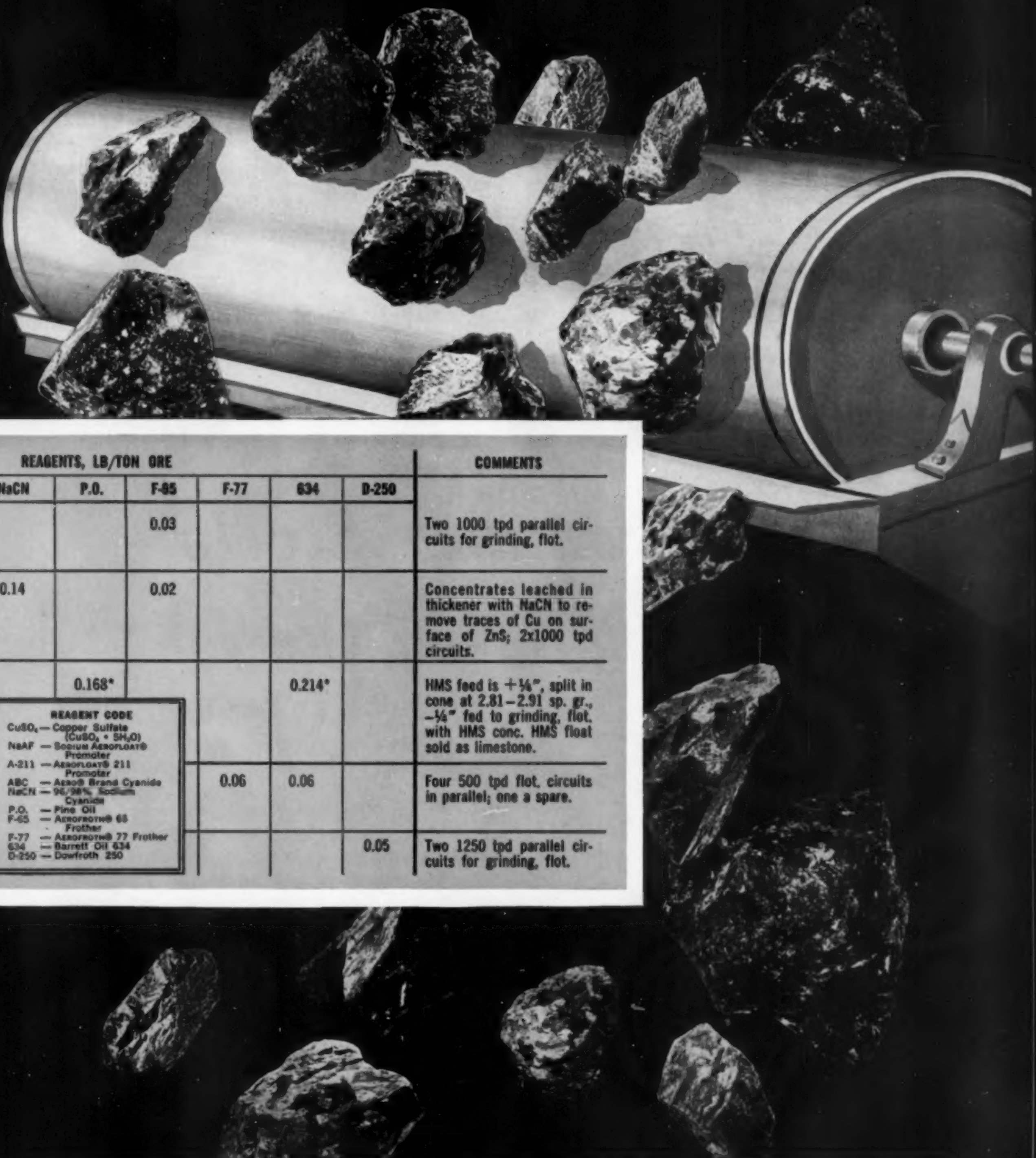
Flotation Reagents **Cyanamid Flocculants** **Chemistry of Cyanidation**
Handling & Feeding AERO® Brand Cyanide **Color Microscopy for the Mill Man**

Our nearest office will provide copies upon request.



REAGENTS, LB/TON ORE						COMMENTS
NaCN	P.O.	F-65	F-77	634	D-250	
		0.03				Two 1000 tpd parallel circuits for grinding, flot.
0.14		0.02				Concentrates leached in thickener with NaCN to remove traces of Cu on surface of ZnS; 2x1000 tpd circuits.
	0.168*			0.214*		HMS feed is +¼", split in cone at 2.81–2.91 sp. gr., –¼" fed to grinding, flot. with HMS conc. HMS float sold as limestone.
			0.06	0.06		Four 500 tpd flot. circuits in parallel; one a spare.
					0.05	Two 1250 tpd parallel circuits for grinding, flot.

REAGENT CODE

- $CuSO_4$ — Copper Sulfate ($CuSO_4 \cdot 5H_2O$)
- NaAF — Sodium Aerofloat® Promoter
- A-211 — Aerofloat® 211 Promoter
- ABC — Aero® Brand Cyanide
- NaCN — 96/98% Sodium Cyanide
- P.O. — Pine Oil
- F-65 — Aerofroth® 65 Frother
- F-77 — Aerofroth® 77 Frother
- 634 — Barrett Oil 634
- D-250 — Dowfroth 250

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Cross section of average extension steel, showing distorted center hole.

Cross section of Sandvik Coromant Steel, showing perfectly uniform center hole.

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Sandvik-originated smooth rope-threads make uncoupling easy.

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What's more, the Sandvik-originated rope-thread makes coupling and uncoupling a hand operation—speeds the job—and reduces chance of incipient cracks developing from wrench marks.

All in all, you can't beat Sandvik Coromant Rope-Thread Steels for fast work and long life! Available from 1½" to 2" in diameter. To set up a test on **your** job, write to your nearest Atlas Copco office today. Address: Dept. ME-17.

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DRY "DUSTLESS" LLV collects cuttings in LX-1 dust box. Operator can empty box by remote control lever on drill.

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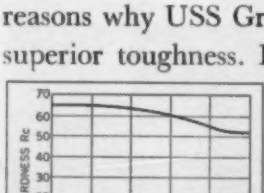

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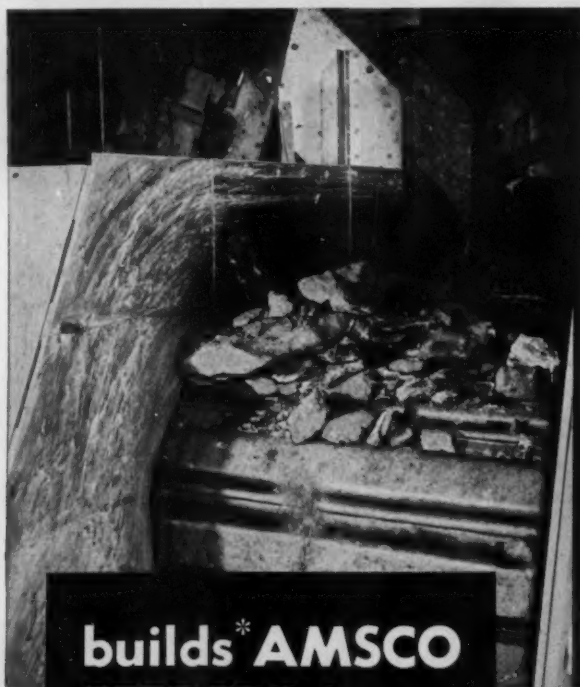

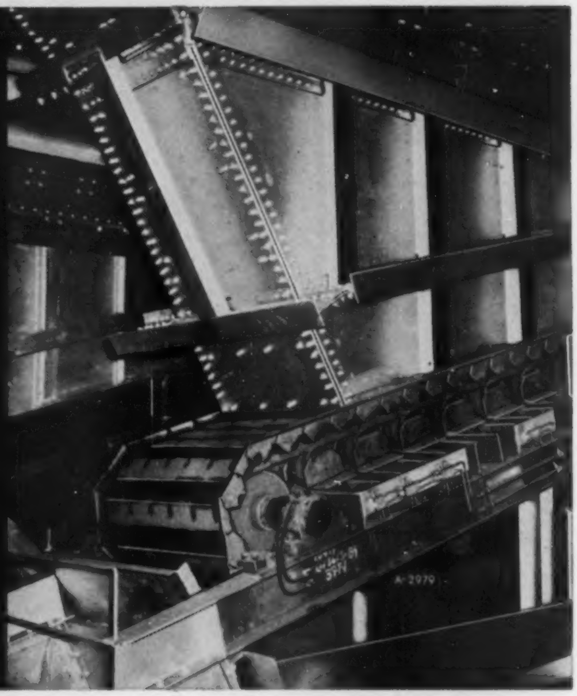

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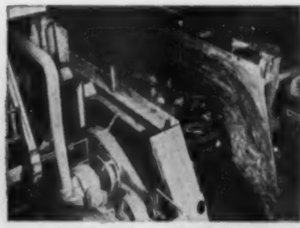

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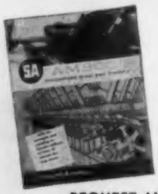

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MINING engineering DRIFT

ENGINEERING UNITY

As a first step dealing with a complex subject, AIME set up a Committee on Inter-Society Cooperation. On the pages immediately following we have a progress report from this group which has examined what cooperation exists and where cooperation works. Many proposals for a unified engineering profession are in the air, and AIME appointed a group to lay the groundwork should it become necessary for our Board to make decisions. Any specific steps are far in the future, however. One example of cooperation which does work is represented by the new United Engineering Center. As pictures in the SME News section show, physical progress is well along.

NOT BY BREAD ALONE

An article entitled "Wage Incentives in Underground Mining" by B. O. Saxberg and R. L. Winter, in this month's issue contains a very important sentence: "Therefore, a more provocative question is whether mine management has been alert to the developments in industrial management within the last 50 years which have indicated that physical or economic incentives form only part of the workers' motivation in an economy where the basic needs for the majority have long ago been met." The authors very properly confined themselves to the specific subject of wage incentives. With equal propriety they point out that there are other incentives, and these other incentives are a subject we would like to see discussed at future AIME meetings. In an era when the term "loyalty" has become almost old-fashioned, and when unions are proclaiming that first loyalty should be to them, it seems pretty important to strengthen company ties to both hourly and monthly employees. Developing loyalty is one of the places where the science of engineering gives way to the art of operating, and it is a subject on which we could all use both ideas and inspiration.

ROUNDUP AT LAS VEGAS

There will be a new kind of stripping show at Las Vegas Oct. 10-13 as a large segment of the mining fraternity gathers at the AIME Mining Show to see not only earthmoving equipment but most of the other equipment used to produce minerals. We will also look forward to seeing most of you at the Rocky Mountain Minerals Conference, Oct. 5, 6, 7, at Salt Lake City.

NEW PLAN FOR UNITY

PROGRESS REPORT OF THE COMMITTEE FOR

There are in this country some 20 or 30 societies for engineers and engineering scientists. Most of these organizations are autonomous, and there is little or no cooperation among them. Many do not touch the lives of our Institute members. However, during the course of the years several societies closely associated with the AIME have banded together to handle specific situations where cooperation was necessary. It is believed by many engineers that the functions of these cooperative societies should be analyzed and a plan set up to unify the engineering profession into an organization similar to the American Medical Association and the American Bar Association.

The preliminary study of the AIME Committee for Inter-Engineering Society Cooperation has indicated that the following organizations bear upon the professional lives of our members. Some of these are federated groups, such as EJC and ECPD; others are individual-member participation groups, such as the Founder Societies and NSPE.

- The five Founder Societies (AIME, ASCE, ASME, AIEE, AIChE).
- The United Engineering Trustees (UET).
- The Engineers Council for Professional Development (ECPD).
- The Engineers Joint Council.
- The National Society of Professional Engineers (NSPE).
- The National Council of State Boards of Engineering Examiners (NCSBEE).

Founder Society is a convenient term used in grouping several early technical organizations—the American Society of Civil Engineers (founded in 1852); American Institute of Mining, Metallurgical, and Petroleum Engineers (1871); American Society of Mechanical Engineers (1880); American Institute of Electrical Engineers (1884); and American Institute of Chemical Engineers (1908). These five societies assumed the responsibility for forming and administering the United Engineering Trustees and have been the organizations most active in the fund-raising campaign for the new engineering building now going up at United Nations Plaza.

FIRST STEP TOWARD UNITY

In 1904 Andrew Carnegie donated $1,050,000 to be used for a building in which to house the activities of the engineering societies. At a meeting in New York representatives of the American Institute of Mining Engineers, American Society of Mechanical Engineers, and American Institute of Electrical Engineers created the United Engineering Society (UES) as a joint holding corporation to administer the proposed new home. This was a major step toward unity of action among the members of the engineering profession. By 1906 the building on 39th Street in New York was completed and UES assumed management.

Until 1916 the American Society of Civil Engineers was housed in its own quarters in New York, but in that year ASCE decided to join UES in the Engineering Societies Building and became the fourth Founder Society. In 1958 the American Institute of Chemical Engineers (AIChE) became the fifth Founder Society to join the cooperative management organization.

United Engineering Trustees: United Engineering Societies became the Engineering Foundation in 1930. A year later it became the presently named United Engineering Trustees Inc. Three trustees each are appointed by the boards of directors of the Founder Societies.

The New Building: During recent years it has been increasingly evident that the crowded quarters of the 39th Street building can no longer accommodate the mushrooming activities of the engineering societies, and in 1958 a national fund-raising campaign was inaugurated to provide a new home for the profession. The success of the campaign is apparent in the building being erected at First Avenue and 47th Street in New York.

UET's history of accomplishment over the past 56 years is a classic example of the ability of engineers of different disciplines to cooperate in a common cause.

STRIDES TOWARD A FURTHER GOAL—AND WHAT WAS LEARNED

In 1916 the Engineering Council was formed. The first four Founder Societies and the UES were each represented by five members in this federation "to provide for the convenient cooperation between Founder Societies, for the proper consideration of questions of general interest to engineers and to the public . . . ."

In 1921 this group became the American Engineering Council, with these stated objectives:

1) To further the public welfare wherever technical and engineering knowledge and experience were involved.
2) To consider and act on matters of common concern to the engineering and allied technical professions.

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INTER-ENGINEERING SOCIETY COOPERATION

by WILL MITCHELL, JR.

Herbert Hoover, an AIME member, then U. S. Secretary of Commerce, was the first President of the American Engineering Council (AEC), which operated effectively until the depression of the thirties. By 1940 the membership had grown to include 54 national, state, and local societies.

In this year, however, the AEC collapsed when three of its largest contributors withdrew financial support. The funds remaining were held in trust for a future similar organization. Dissolution of the American Engineering Council demonstrated the inherent weakness of a federation type of unity organization.

Engineers Joint Council—Membership and Scope: In 1941 the Engineers Joint Council was formed "to consider joint efforts in national defense." The Council was composed of the officers of the Founder Societies. First called the Joint Conference Committee, it became the Engineers Joint Conference, and finally in 1945 the Engineers Joint Council, at which time a constitution was adopted.

In 1943 each member society provided three representatives to recommend a plan for organizing the engineering profession. After considerable discussion and negotiation it was decided in 1952 to admit other than the five Founder Societies to EJC and to provide for representation from the constituent societies in proportion to their membership. EJC Board members are appointed by the boards of directors of the technical societies.

By 1958 EJC included in its federation eleven constituent societies, three associate societies, and seven affiliate societies. It claimed a federated enrollment of "almost 300,000 individual members."

The scope of EJC includes: atomic energy; engineering manpower; air pollution; engineering sciences; honors; international relations; and recognition of specialties in engineering.

BUT WHAT OF THE INDIVIDUAL?

Still, professional engineers lacked a common meeting ground. Where could the individual, a trained professional man, seek help in advancing his career? What assurance could he find that his training was taking him in the right direction? If his training met the requirements in one state, would it satisfy professional engineering standards in another?

Engineers Council for Professional Development: In 1932 representatives of the following groups—the five Founder Societies, the National Council of State Boards of Engineering Examiners, the Society for the Promotion of Engineering Education (since called the American Society for Engineering Education), and the Engineering Institute of Canada—established the Engineers Council for Professional Development (ECPD). Originally the Council was formed "to advance the engineer professionally through the cooperative support of those national organizations directly representing the professional, scientific, educational and legislative phases of the engineer's life." Its scope has since been expanded to include:

1) Education and development of young engineers.
2) Establishment of standards for engineering education.
3) Accreditation of engineering curricula.
4) Canon of ethics.

ECPD is a federation governed by a board made up of three representatives of each member society. These representatives are appointed by the boards of directors of the societies involved. Through the years the splendid cooperation of the member societies and the wisdom of the various governing boards of ECPD have engendered great respect from engineers and from the public. ECPD is mentioned as an authoritative voice in the laws of 41 states.

National Society of Professional Engineers: The National Society of Professional Engineers was formed in 1934. Ever-increasing technological specialization was leading to the formation of more and more technical societies, but it was realized that

Committee to Investigate Inter-Engineering Society Cooperation

The AIME Committee for Inter-Engineering Society Cooperation was appointed in February 1960 as an information-gathering group, to report its findings to the Board. As the preliminary study progressed, each member of the three-man committee was assigned to cover the activities of a society or group of societies touching the professional lives of AIME members. Will Mitchell, Jr., of the Society of Mining Engineers covered the activities of the National Society of Professional Engineers; Robert M. Mahoney of the Metallurgical Society was assigned to study the scope and organization of the Engineers Joint Council and the National Council of State Boards of Engineering Examiners; and Douglas Ragland, Petroleum Engineers, covered the activities of the Engineers Council for Professional Development.

some problems are common to all engineers, especially in their professional responsibilities. It was recognized that advancement of the arts and sciences of engineering was receiving adequate attention from the various technical organizations; hence NSPE proposed not to interfere in the technical field, but devoted itself to the areas of common interest—professional, social, economic, and ethical.

NSPE is not a federation. It is similar in organization to the Founder Societies in that it is composed of individual dues-paying members who are professional engineers. Members meet on the local, state, and national levels. The society elects its own officers, the individual having a voice in all affairs.

Registration laws covering the practice of engineering have now been enacted in all states; hence registration has become a basic requirement for admission to NSPE; the few exceptions to this requirement are beyond the scope of this report. There is only one grade of membership in NSPE at the present time.

STATE ACCREDITATION—THE NEED FOR UNIFORM STANDARDS

Wyoming in 1907 passed the first law requiring registration of engineers in our country. By 1920, all states had similar laws on their books, and today all 50 states have registration laws for engineers.

National Council of State Boards of Engineering Examiners: This organization was founded in 1920 "to promote the public welfare by improving professional engineering standards through efficient administration of State Engineering Registration Laws, by facilitating interstate registration of engineers, and by defining and maintaining national qualifications for registration."

Officials of the NCSBEE are actively working on a revised "Model Law," which it is hoped will be adopted by all state legislatures in the interest of uniformity and consistency. Members of the state boards are appointed by the governor or an authorized representative of the state legislative body. In general, these members are selected upon recommendation by the state or national professional societies, or both.

INTER-ENGINEERING SOCIETIES COOPERATION

Recently NSPE canvassed its membership of more than 50,000 with a questionnaire on organization of the profession. It is interesting to note that of the 15,000 who replied, 20 pct are also members of ASCE, 15 pct belong to AIEE, and 13 pct to ASME; 2.7 pct claim membership in AIME and 2.6 pct claim membership in AIChE. It was indicated that 75 pct of the members of NSPE belong to one or more technical societies.

It should be noted that NSPE in its Policy No. 51 has recommended that every member of NSPE should "join and support the work of the technical society which serves his particular field of practice."

AIEE has proposed what is called the Functional Plan, in the hope that this will be the first step toward unity in the profession. The plan attempts to delineate the scope of the responsibilities of EJC, ECPD, and NSPE by proposing:

1) That cooperative action on technical and other related matters be a function of the Engineers Joint Council.
2) That cooperative action in the field of engineering education and the canon of ethics be the responsibility of the Engineers Council for Professional Development.
3) That the National Society of Professional Engineers be responsible for furthering the development of the professional interests of the engineers.

The American Society of Mechanical Engineers has gone on record as being in favor of this plan.

Another recent proposal is that the Engineers Council for Professional Development and the Engineers Joint Council be consolidated and that a third department be created to handle professional activities. Under this arrangement registration of members would probably not be a requirement.

TAX REGULATIONS

Any realistic plan for unity, however, must take into consideration some tax rulings established by the Internal Revenue Department. The department classes voluntary membership organizations into:

1) Educational, scientific, religious, and charitable (501-C-3 classification).

The Founder Societies, United Engineering Trustees, and Engineers Council for Professional Development fall under this classification. The 501-C-3 organizations can receive donations and gifts that are tax deductible to the donor. They also are privileged to receive a real-estate tax exemption.

2) Trade associations, chambers of commerce, etc. (501-C-6 classification) whose objectives include the improvement of the economic welfare of their members.

Organizations such as the American Mining Congress, The Mining and Metallurgical Society, the National Society of Professional Engineers, the American Medical Association, the American Bar Association, all fall into this group. These societies can not receive the tax benefits mentioned above. No funds from organizations classed as 501-C-3 may be contributed to the organizations listed as 501-C-6. However, funds from the organizations classed as 501-C-6 may be accepted by those enjoying a 501-C-3 classification.

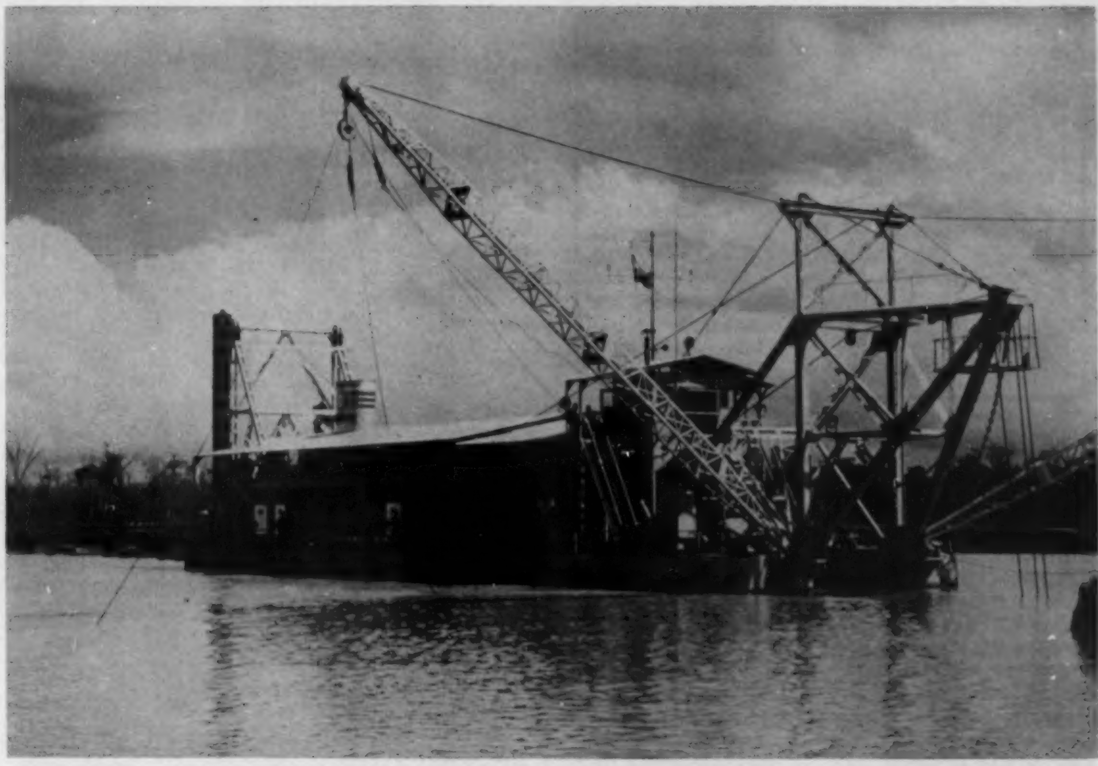
The Engineers Joint Council, before its recent incorporation, was classified under 501-C-6. Under its new charter all references to activities of a professional nature have been omitted and EJC has requested reclassification as a 501-C-3 group.

WHERE TO FIND MORE INFORMATION

This résumé is presented here to let our members know what has been done and what is being done in the interests of Inter-Society Cooperation. For those who may want to study the matter in greater detail the publications listed below will be helpful.

The Organization of the Engineering Profession (NSPE).
Organizing the Engineering Profession to Achieve Unity (AIEE).
Organization of the Engineering Profession—Background and NSPE Member Opinion (NSPE).
EJC Annual Report, 1958.
Charter and Rules of Procedure, Engineers Council for Professional Development, Revised Oct. 20, 1951.
The Registration Bulletin (NCSBEE). Published quarterly.

The investigating committee has used these publications for its report and has quoted freely from them. The committee is offering no conclusions or recommendations at this time.



The "Akanswarie" has the star role in Alcoa's project of developing a bauxite deposit in Surinam by . . . .

STRIPPING OVERBURDEN WITH A DREDGE

by JOHN G. CAZORT, JR.

In August 1957, a cutter suction dredge started the removal of overburden from a bauxite deposit near Paranam, Surinam (formerly Dutch Guiana), South America. This event marked the climax of a program of investigation, design and construction which lasted almost five years. Cutter-suction dredges are used predominantly for harbor and river work, and land reclamation. While they have been utilized to remove overburden from ore bodies, notably at Steep Rock, Ontario, and Black Lake, Quebec, the conditions under which one is being used for this purpose in Surinam are unusual.

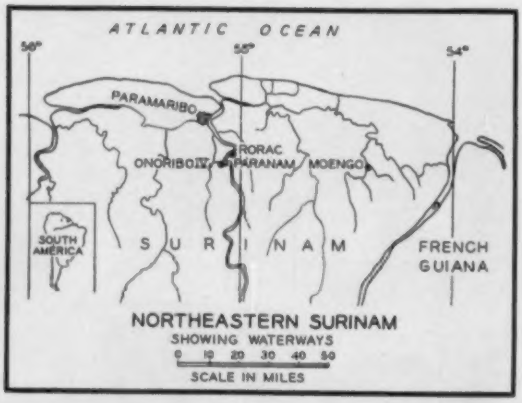
Paranam is a mining town built by Suriname Aluminum Company, a subsidiary of Aluminum Company of America. It is located on the Surinam River, about 30 miles from the Atlantic Ocean. The bauxite mining, drying and shiploading facilities have been in operation since 1941.

J. G. CAZORT, JR., is a Mining Engineer with Aluminum Company of America, Pittsburgh, Pa. From 1955 to 1959, he was associated with the Suriname Aluminum Co. as Assistant Mine Superintendent at Moengo, and as Dredging Superintendent at Paranam.

"ONORIBO IV"

Onoribo IV, as the deposit is named, was discovered in 1952. This discovery was one of the results of an extensive exploration program in the Paranam area. Exploration drilling was continued into 1953, when the limits of the ore body were determined. It was soon apparent that the topographical and geological features of the deposit, in all probability, would not permit stripping by methods with which the operating personnel in Paranam were familiar.

The ore body lies 27 to 50 ft below sea level, under a tidal river at the edge of the coastal plane. On one side of the river valley, hills rise to an elevation of about 50 ft above mean sea level. On the



NORTHEASTERN SURINAM
SHOWING WATERWAYS

other side of the river the land slopes gently to an elevation of about 10 ft. The valley contains large areas of swamps which appear to be filled oxbows of the meandering river.

Geologically, the deposit is believed to have been formed by the intensive weathering of moderately aluminous sediments. The overlying sediments are known to be of recent age, but the age of the bauxite and underlying sediments are still the subject of considerable debate.

The ore body is a lens-type deposit covering a rectangular area approximately 2200 x 4000 ft. Structurally, it has the shape of a symmetrical anticline plunging slightly to the north with the long axis parallel to the long axis of the ore body.

The overburden consists of silt, sand, sandy clay and clay which vary from very soft to very hard. It is estimated that about 60 pct of the overburden is very soft marine clay which is impervious and occurring over most of the area. Medium and hard clays comprise about 20 pct of the volume. These clays are present in thin layers overlying most of the bauxite. Sand lenses occur between the bottom firm clays and the upper soft clays. This sand varies from fine to coarse, is very sharp, and occupies about 10 pct of the volume. The remaining 10 pct is composed of silt and sandy clay which occur at random at, or near, the surface.

CONSIDERATION OF STRIPPING METHOD

At the time of discovery of Onoribo IV deposit, other deposits had been investigated which could be most economically stripped by dry methods. It was hoped that all the deposits could be developed using the same equipment. With this in mind, investigations were conducted to determine if the overburden could be handled with large draglines. Soil samples were taken and sent to laboratories for study and a test shaft was sunk in the soft clay to see if the adjacent ground water level could be lowered. In-place determinations of the bearing capacity of the clay were made. These tests showed the following characteristics that 1) the soft clay would not support a dragline, even working on mats, close enough to the pit to allow one cast stripping, and 2) the clay was impervious and could not be dewatered enough to materially change its physical characteristics.

These results, as well as the observation of a stripping operation in similar material, showed that a large part of the material would have to be removed from the pit prior to mining. The material was known to be too soft to be removed by trucking. Haul roads would be very difficult and expensive to construct and maintain in, or over, the soft clay. Therefore, either a combined wet and dry, or an entirely wet operation was indicated.

Soft marine clay of similar depth has been handled successfully by combined hydraulic and dragline stripping. However, the operational costs of such a method were believed to be high due to the fact that the clay was not broken down by running water. Each piece had to be struck by the jet to reduce it in size enough for the material to flow to a sump from which it could be pumped into a spoil disposal area. In addition, the dragline would have to work from the lower harder clays and dig most of the material from this disadvantageous position.

The remaining choice was dredging, and three types of dredges were considered. These were barge-mounted cranes with clamshell buckets, bucket line dredges, and cutter-suction dredges.

Investigation showed that a cutter-suction dredge would be less expensive to buy, operate, and maintain than either a bucket line dredge or barge-mounted crane of comparable capacity with built-in hopper and pump. In any case the pump size would be the same and the ladder, cutter installation and suction pipeline were less expensive than either the bucket line system or a crane with several cu yd capacity. There was a question pertaining to the ability of a cutter-suction dredge to handle the stiff clay. Fortunately, there was available for rental in Surinam a small cutter-suction dredge. Since the river had to be diverted in any case, it was decided to rent this dredge to cut the relocation canal. After this operation was successfully completed, no doubt remained about the ability of a cutter-suction dredge to handle the overburden.

PREPARATIONS FOR DREDGING

The only available area for spoil disposal was about 2,000 ft from the edge of the ore body. A two-section spoil disposal area was designed of sufficient size to allow clear water discharge into an existing canal which connected the Para River with the Surinam River. Clear water discharge was necessary because the canal was used by inhabitants of the area for washing and bathing. As the spoil area fills with material, the settling time is reduced and the discharge contains more solids. To control this, a spillway was designed in which boards could be placed to raise the water level. Movable gates were specified for control of the discharge from the clear water pond into the canal.

The construction stage started with the diversion of the river as mentioned previously, by relocating the river channel. The old river was plugged with hard clay and non-commercial bauxite. This plug forms a part of the future haulage road. A seven-span steel and concrete bridge 266 ft long and 36 ft wide was constructed over the relocated river channel as part of a future haulage road to Onoribo IV and another ore body. In addition, an existing road bridge across the Para Canal on the highway between Paranam and Paramaribo had to be rebuilt with a removable center span to allow the dredge to be towed into the dredging area.

The spoil disposal area was cleared only along the dike lines to afford access for equipment. The remaining vegetation acts as a barrier to water flow and increases the settling rate of the spoil.

Several methods were employed for construction of the spoil area dikes. Where the ground was swampy, the dikes were built by barge-mounted

cranes using clamshell buckets. A large section within the spoil area near the main haulage road contained hard clay and was used as a pit. Trucks were loaded by draglines and used for building roads, and reinforcing and heightening weak dike sections. There were so many weak sections that a road was finally built around the entire perimeter of the main spoil area. This road gives access to all dikes in case repairs are necessary, and acts as a counterweight against the dikes and enclosed spoil.

The pipeline dikes extending into the spoil area were built as a safety measure in case the spoil would not support personnel and pipes. Trestles were built to support the pipes across the swamp areas where dikes could not be built.

To prevent flooding of the pit a protective dike was built around the dredging area to intercept surface water and direct it to the river. It was not considered practical to remove the underlying peat and silt because the head on this dike would always be low and leakage could be controlled. The haulage road acts as a dike on the south side. The northern section will be a road to bring clay and non-commercial grade bauxite to the old river downstream from the pit after dredging has been completed.

A 24-in. ID pipeline was laid from the Para River at the point where the dredging operation was to start, to the southern pipeline dike on the spoil area. There, a wye and gate valves were installed so the spoil could be directed to either side of the dike.

PIPELINE DESCRIPTION

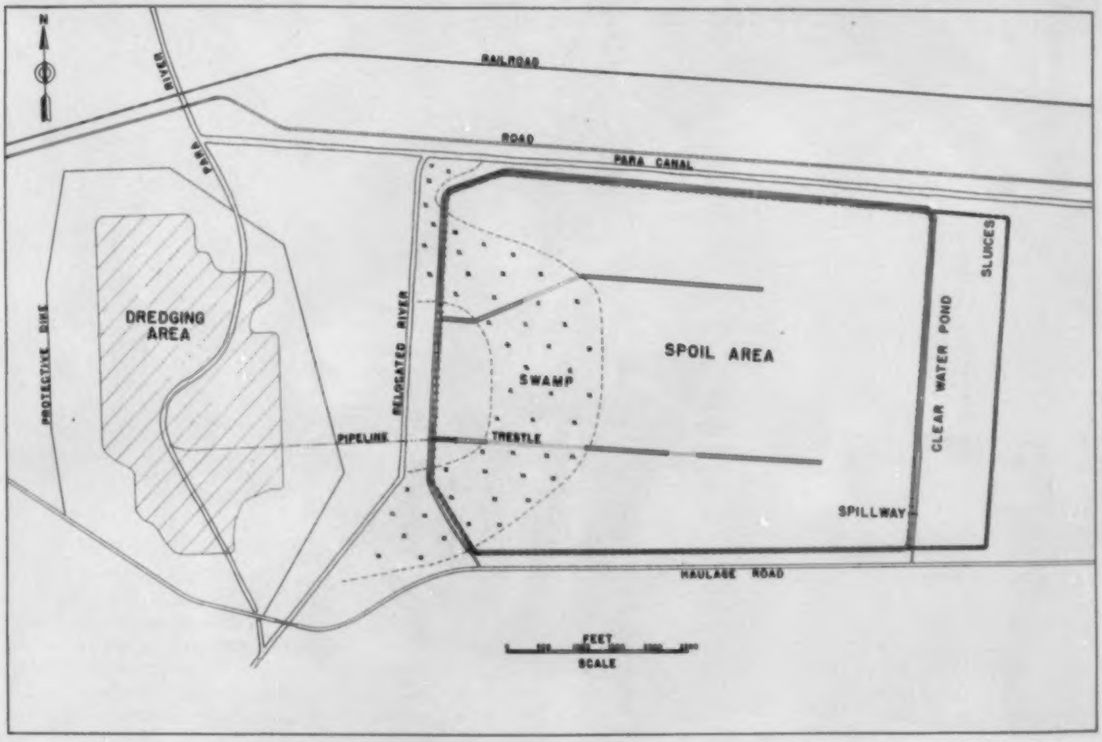
The 24-in. ID pipe, serving as a spoil discharge pipeline aboard the dredge, is flange-connected. Straight sections of this line are made of welded ½-in. steel plate. The elbows are cast and have a greater thickness on the outside of the bends to compensate for increased wear at those points. This line terminates in a swivel or "goose neck" at the stern of the dredge.

Connected to the goose-neck is a floating pipeline consisting of up to 1240 ft of ½-in. welded pipe. These pipe sections are coupled with ball joints, and the total length varied as required. Right and left-handed elbows permit dredging in almost any direction from a single shore connection. The pipes are supported by cylindrical pontoons that place the pipe sections at a uniform height above the water level. This permits very fast coupling and uncoupling of the ball joints.

On the shore between the floating pipeline and the spoil area, the pipeline is of either ½-in. or ¼-in. welded steel plate. The ¼-in. thick pipe is used on that part of the pipeline that extends over the area to be dredged. This facilitates handling of this pipe, much of which crosses a swamp having about 3 ft of water at high tide. Cribs of old railroad cross-ties were built across this swamp and 60-lb rails were spiked to them to prevent them from floating away as well as to help support the pipes. Where the pipeline crosses the relocated river channel, a 50-ft long pipe section was installed on piling supported saddles.

On the spoil area either ¼-in. steel or ¼-in. aluminum pipes are used. The aluminum pipe is used on the soft spoil where the handling of the heavier steel pipe is very difficult.

The aluminum pipes on the spoil area wear more rapidly than the steel pipes as expected. Since the spoil now being pumped gives good support to men, the aluminum pipes are being reserved for use when the bulk of the spoil will be very soft. On these pipes, as well as on the light steel pipes for use on the spoil area, the tapered coupling is ideal. The



Map of dredging and spoil areas at the start of operations at Onoribo IV.

pipes can be coupled on the spoil in a very short time without having to use bolts or other devices in the mud. We believe this saving in time more than compensates for the excessive wear.

DESCRIPTION OF DREDGE

As the spoil area and pipeline preparations were nearing completion, the dredge arrived in Surinam. It had been given the name *Akanswarie* as a result of a contest among the Paranam employees. *Akanswarie* is a word in the native dialect of Surinam meaning "it can swallow" and is synonymous with the term "glutton."

The dimensions of the dredge hull are about 144 ft x 36 ft. It draws 7½ ft of water and weighs approximately 1100 tons. The dredge pump is powered by a 12-cylinder, *V*-type turbocharged marine diesel engine rated at 3,200 bhp at 350 rpm. An adjustable torque-limiting coupling is installed between the engine and the pump.

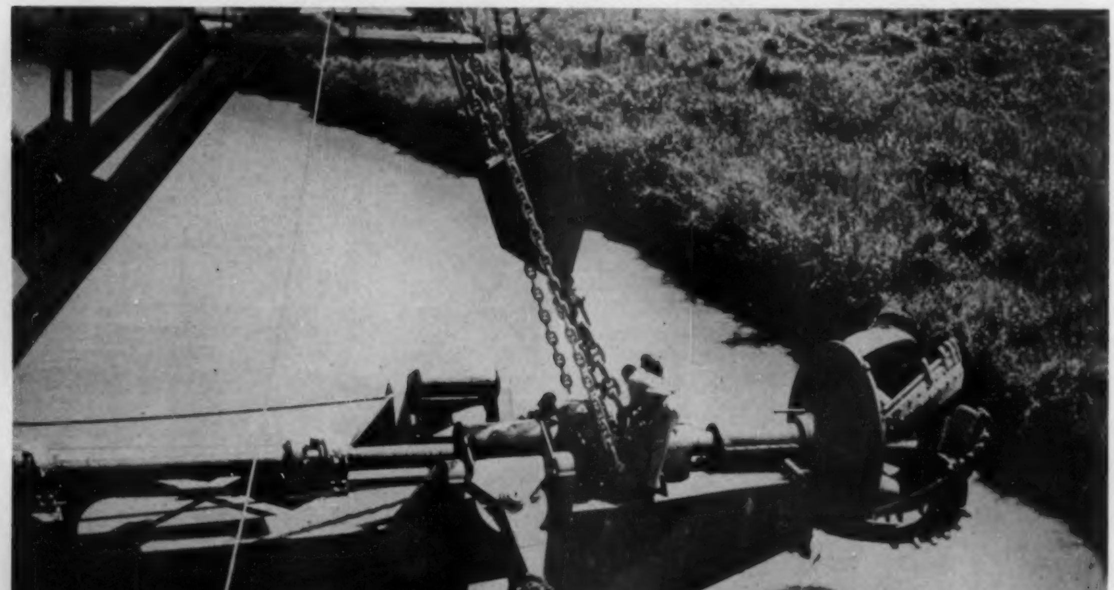
The dredge pump, which has a capacity of about 30,000 gpm, is a 24-in. centrifugal pump approximately 9½ ft in diameter. It consists of a one-piece pump housing, plus removable covers, shoulder liners, impeller, and necessary bearings and stuffing box. The pump housing weighs about 14 tons. A separate floating crane is used to remove the pump parts from the pump room through an overhead hatch.

Two types of closed impellers were provided with the pump. This was desirable because the head to be overcome varies greatly as pipeline length and lift change. One impeller has four vanes, and is generally used on shorter pipelines. A five-vane impeller is used when the length and lift increase. It is not practical to change impellers except when the wear in the housing or liners becomes great. At that time, it is estimated what the general conditions will be before another pump change is necessary, and the proper impeller selected accordingly. A complete pump change requires about 24 hours.

The pump specifications provide for a capacity of 800 cu yd per hour of overburden when pumping a mixture consisting of 13 pct solids by volume through 7,000 ft of pipeline with a terminal elevation 60 ft above the surface of the water. These length and lift conditions have never been reached, but velocity tests under other conditions indicate that the pump is more than capable of fulfilling those requirements. The capacity varies greatly as overburden conditions change. During one day the production was over 2,500 cu yd per hour, and solids content ran as high as 40 pct. Normal production on an 8-hour shift averages about 150,000 cu yd per month. The dredge is presently operating two shifts a day. The accompanying table indicates how production and pipeline conditions change with different types of overburden.

The electrical generating engine is a six-cylinder, turbocharged, in line, diesel engine rated at 1200 bhp at 514 rpm. This engine drives a 350 kw d-c generator, a 375 kva, a-c generator, and a 10 kw exciter. These generators supply power for driving the cutter, winches, compressors, various pumps, and miscellaneous electrical equipment. A 43 hp diesel auxiliary engine supplies power for lights, pumps, compressors, and heating elements when the generating engine is not in operation.

The cutter is driven by a d-c motor capable of developing up to 400 hp continuously at 650 rpm. The maximum speed of the motor is 900 rpm. A triple reduction gear with an overall ratio of 30:1 reduces



View of the crown-shaped cutter (right) and forward section of the 79-ft long cutter ladder.

Located on the stern of the "Akanswarie" are the spuds (left) and the spud gantry. The spuds serve to pivot the dredge through a 55-ft arc during stripping operations.

the operating speed to 30 rpm. The cutter drive motor is reversible.

The movement of the dredge is controlled from a central winch installation. This installation is split into starboard and port winch systems. Each is driven by a 94 hp d-c motor. Power for these motors is derived from two generators (one for each motor) driven by a separate a-c motor. A coupling makes it possible to operate all winches with one motor in case of repairs on the other. This would make the operation of the dredge more difficult, and would be done only in an emergency. All the winches are operated pneumatically from the operator's cabin.

The 79-ft long cutter ladder weighs almost 100 tons when complete. On it are mounted the cutter motor and gears, the cutter shaft and cutter, part of the suction pipeline, and swing wire sheaves. The ladder is movable only in a vertical direction and the depth of cut is controlled in this manner. The maximum dredging depth is 45 ft. Two types of cutters were provided, a knife or straight cutter weighing about 3 tons, and a crown or basket cutter weighing about 5 tons. Each type consists of a single steel casting with removable cutting knives. Teeth were welded on the knives to reduce wear in sandy material. Individual suction mouths are provided for each type of cutter.

The dredge is provided with two anchor booms mounted on the forward deck. Each boom is 87 ft long and held by pennants in a fixed vertical position about 25° from horizontal. Capable of pivoting 55° in a horizontal plane, these booms are used to lift and advance the anchors, thus avoiding the necessity of using anchor barges.

In addition, two cylindrical steel spuds, each 67 ft long and weighing 15 tons, are installed in spud wells at the rear of the dredge. The spuds are free to slide vertically and rotate in their wells.

METHOD OF DREDGE OPERATION

The dredge movement and operation is completely controlled by the operator. After the anchor has been set on each side, the starboard or "walking" spud is dropped, and the port or "working" spud, raised. The dredge is then pivoted around the spud through a 55-ft arc about the cutter. This advances the working spud to a point on the centerline of the cut about six ft forward of its previous position. This spud is then dropped and the walking spud raised. With the dredge pivoting on the working spud, the cutter ladder is drawn toward each anchor alternately by means of the swing wires. The cutter is lowered on each successive swing until the "step" is finished. The quantity of material entering the suction pipeline is controlled by the amount the cutter is lowered and the speed at which the operator swings the dredge. Vacuum and pressure gauges, as well as "feel" and communication with the discharge point, indicate to the operator how much material he can pump without danger of choking off the pump by too high vacuum, or plugging the discharge pipeline with material. The original cuts were made in the planned sequence, but one major change was made in the operating plans. The deep banks cut by the dredge caved badly; to prevent this, step or bench cuts were made. These cuts were made in such a way that the maximum height of the bank at any point was about 25 ft. This system resulted in lower production per hour but insured a relatively clean bauxite surface.

AUXILIARY EQUIPMENT

Several pieces of equipment are required for the operation, in addition to the dredge. The dredge is not equipped with a crane for hoisting parts overboard; a 40-ton locomotive type crane is mounted on a barge for this purpose. The car body was removed from the crane and the base was bolted and welded to the barge. This barge provides storage space for pump parts and shore pipes, etc. It is also used to lift out the highway bridge when the dredge passes through the canal to other jobs.

A 40-ft dredge tender, capable of either pushing or pulling and propelled by a 150 hp diesel engine, is used to shift the dredge and barge and to handle pontoon pipes. This tender plus other outboard powered boats are used for the transportation of personnel.

The dredge receives its fuel from storage tanks in Paranam via a 12,000-gal capacity fuel barge. The present fuel consumption requires about five trips a month by this barge. The dredge tender and barge makes a round trip between Onoribo IV and Paranam by way of the canal system in one day.

PERSONNEL

The dredge is now working two shifts a day, six days a week. Thirty-three men are permanently assigned to the dredge and spoil area. All men on the

View of the discharge pipeline (traversing from center foreground to right background) leading into spoil area.

dredge report directly to the Chief Dredgemaster who also supervises the spoil area work. Each shift has an operating crew of one dredgemaster and three deck hands, one of whom operates the tender when required. The engine room has a general supervisor and eight men divided into four shifts of two men each.

The day shift has a regular tender operator and an extra deck hand, as well as one electrician. The crane operators, readily available from the mining department, are needed only when a pump change is required or pipeline work is being done.

The spoil area has a foreman who reports directly to the Chief Dredgemaster. Each crew has two men who stand by the end of the pipeline and help direct the spoil flow with baffles and shovels, and keep the Dredgemaster informed of the spoil area situation by sound-powered telephones. There are seven laborers in the day crew who handle shore pipes, clean the spillway and sluices, inspect the dikes, etc. When needed, additional men are available from a labor pool in Paranam.

FINAL PREPARATIONS FOR MINING

As soon as the dredge has completed its work on Onoribo IV, it will be moved from the lake. The surrounding dike will then be completed and the river dammed. It will be necessary to do this as soon as possible because the large volume of silt carried by the rivers and canals will settle in the still water.

The next step will be dewatering the pit. As dewatering progresses to a point where the bauxite is exposed, the thickness and physical condition of the silt now being deposited by the river can be determined. It is expected that this material will be very soft and may run to the pumps without assistance. If not, it can be washed to the pumps. Simple monitor barges have been proposed for this purpose, if necessary.

DEVELOPMENT COSTS

It is expected that by the time bauxite is being produced, \$2.9 million will have been invested. This is exclusive of the investment in mining and milling equipment, as well as interest on the investment, but includes all other expenditures.

The stripping cost to date has averaged \$0.1962 per cu yd. Because most of the more difficult to pump material such as hard clay and coarse sand has been removed, the future costs should be lower.

An examination of the cost data shows that 56 pct of the stripping expense is accounted for in three main items.

1) Repair and maintenance, which now averages 16 pct of the total cost, is increasing continuously but such costs are expected to become more uniform in the future.

2) Applied initial costs account for 16 pct of the stripping cost. Included in this account are such items as construction of the spoil area, cutting of the diversion canal, clearing of Onoribo IV, etc. Most of this money was spent before dredging was commenced.

3) Dredge rental, which is based on a depreciation rate of 10 pct, is the largest single item of expense. This cost is uniform for each month of operation, and the percentage of the total is largely dependent on the number of shifts worked. This cost has varied from 20.7 to 27.5 pct of the total development costs.

FUTURE OPERATIONS

As a result of the experience gained while dredging Onoribo IV, several important conclusions have been drawn which will influence future dredging of overburden from bauxite deposits. The first and most important conclusion is that proper and complete investigation of the overburden characteristics can eliminate considerable costly dike building. There is no need for high dikes surrounding the spoil area, provided the spoil can be built to considerable height at the discharge point. One ft of lift is roughly equivalent in head to 25 ft of 24-in. pipe. Since the shape of the discharged spoil approximates a cone with slightly shallower slopes in the direction of the discharge, an increase of one ft of height allows many times more material to be discharged from a single point.

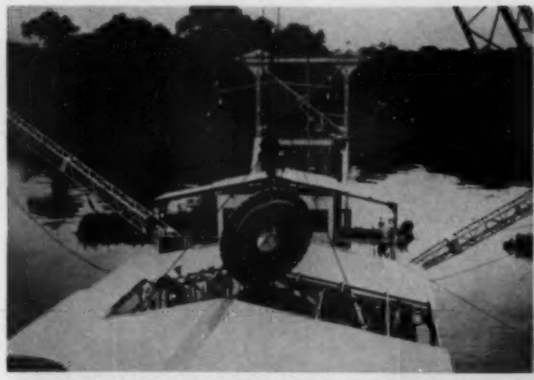
It should be kept in mind when designing spoil areas in swampy ground areas, that an increase in area permits lower dikes and therefore a safer spoil disposal. However, the land covered by the soft silt will not be usable for other purposes for many years, and the value of this land must be weighed against the cost of higher dikes in a smaller area. In an uninhabited jungle, no dike enclosed spoil area would be needed and perhaps no high initial starting point, provided the spoil would build up. In a densely populated area with clear streams, all the spoil must be contained, and a complete spoil area such as that near Paranam is required.

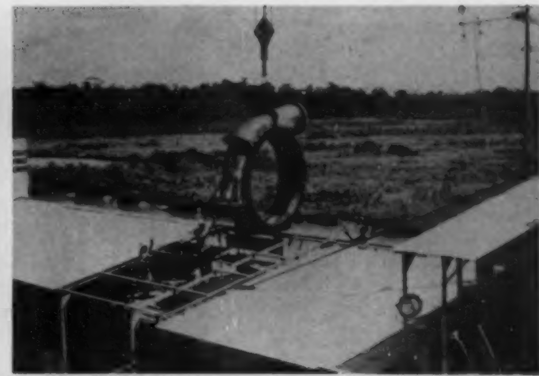
Pipelines should be so located that they can be reached at all points by either floating cranes or bulldozers, even on the spoil area, if practical. It is cheaper to cut a shallow canal or build a bulldozer road than turn all worn pipes by hand. Also, if a pipe plugs where it must be taken apart, a crane

Table I. Production And Pipeline Conditions*

Material Pumped	Average Production Per Hour Pumping Material, cu yds	Average Production Per 8-Hour Shift, cu yds	Pipeline Velocities (ft per sec)		Pct Solids (Bank Volume)		Net Friction Head (ft of water)		Friction Head Loss ft per 100 ft of pipe		Normal Static Head (equivalent ft of water)
			Normal	Critical	Normal	Critical	Normal	Critical	Normal	Critical	
Water			18				220		3.41		30
Silt	1500	7500	14	10	28	Over 40	264	271	4.06	4.18	36
Soft Clay	1500	7500	14	10	28	Over 40	266	274	4.09	4.22	34
Medium Clay	1000	5000	15	12	16	20-25	251	272	3.87	4.17	35
Hard Clay	900	4500	16	‡	14	‡	229	‡	3.53	‡	35
Fine Sand	1200	7000	15	‡	20	‡	240	‡	3.70	‡	36
Coarse Sand	1000	5000	16	‡	15	‡	230	‡	3.54	‡	34
Average Material	1150	6000	15	‡	19	‡	241	‡	3.71	‡	35

* Average Conditions: Equivalent Pipeline Length = 6500 ft; Life = 30 ft.
‡ Data not available.
NOTE: All values estimated except for "Water".





Left, front cover of pump being removed during a pump change. Right, pump case being hoisted from the dredge.

or bulldozer is necessary. All Onoribo IV pipelines can be reached by such equipment, except on the spoil where the material is too soft.

Every effort should be made to keep the pipelines as short as possible. This results in decreased fuel consumption and overall pipe wear and an increase in production.

ADVANTAGES AND DISADVANTAGES OF USING DREDGING AS A STRIPPING METHOD

While numerous advantages and disadvantages could be listed, a few are worthy of particular mention. Where the overburden must be removed from the immediate vicinity, a hydraulic monitor with an open flume discharge is undoubtedly the cheapest method. However, the topography will usually not permit this method to be used, and when the material has to be pumped away, cutter-suction dredging becomes more and more attractive. The cutter gives more control over the volume of solids removed than either hydraulic monitors or suction pipes alone. Cutters can handle very hard clays and thin layers of rock or shale with very little trouble. Gravels containing boulders several inches in diameter have been handled in many places. This versatility enables the use of a cutter-suction dredge where no other method would be economical. The low cost per cu yd of material removed from Onoribo IV could not be approached by any other method.

A second advantage of dredging is the resulting safety of the mining operation. This was particularly true on Onoribo IV, where dry excavation might have been impossible. The dredged pit on Onoribo IV should allow clean mining with good drainage to sumps. The roads on top of the bauxite will permit haulage without much regard to the weather.

A third advantage where ocean or river transportation of the ore is used is the ability of a cutter-suction dredge to cut channels and dock space. For four months during 1959, the dredge was used for deepening four miles of river channels and cleaning out silt from a dock area.

There are disadvantages that might discourage the use of a dredge for overburden removal. First there is the high initial cost of the equipment and spoil area. Dredges are available in a very wide price range, and should be bought to satisfy the conditions under which they will be used. Primary questions to be considered in the selection of a dredge are: 1) how much time may be spent dredging before production is required; 2) what are the head requirements for the pump; 3) what are the overburden characteristics; and 4) what will be the final cost per cu yd of material removed? While dredges can be leased with or without crews, and dredging contractors are available for complete operations, the final cost is the governing factor.

A second disadvantage in the case of the mine operator buying or leasing a dredge, is the lack of experienced dredging personnel—particularly in the remote areas. Suriname Aluminum Company was fortunate in that the official language of Surinam is Dutch, and Holland has been a dredging country for hundreds of years. Capable dredgemasters were employed who have developed inexperienced young men into an efficient crew. Two of the more adaptable Surinam men are now in training as lever men. Experienced engine room personnel were taken from the Paranam powerhouse and have done an excellent job aboard the *Akanswarie*.

CONCLUSIONS

Today, dredging is generally considered when all other methods of overburden removal have been considered and rejected. This has probably been due to the lack of information about the capabilities of various types of dredges. Bucket-line dredges have been used for years to mine gold and tin. Both of these industries have used cutter-suction dredges for removal of overburden and for cutting channels to float the mineral recovering dredges. Recent years have seen the successful use of dredges for stripping both iron and asbestos orebodies.

In general, cutter-suction dredges are used for land reclamation, harbor and waterway development and maintenance, and overburden removal. In some cases they have been used in the production of construction material such as sand and gravel as well as marine deposits for cement manufacture, but suction dredges or other methods are more normally employed. In overburden removal there must be an area for depcsition of material within a reasonable distance. By using booster pumps this may be several miles away, and the economics of each project must be studied individually. A plentiful water supply is required. In all cases the overburden itself must be studied to determine the ability of a cutter to handle it.

As dredging information becomes more available to mining men in general, it is believed that this will become a more universally accepted method of stripping.

WIRE ROPE SIDEFRAME BELT CONVEYORS AT BEN CREEK NO. 2 MINE

by E. MORGAN MASSEY

Located in virgin coal acreage near Gilbert, W. Va., Massey Coal Mining Co.'s Ben Creek No. 2 mine afforded the company's engineers the opportunity of designing and laying out the entire mining operation from the mine faces to the railroading loading site. However, the topography of this region posed difficult problems in haulage of coal for, in this extremely rugged terrain the uppermost coal seams lay in the mountain-top ridges, approximately 1400 ft above the valley floor.

The decision for mining equipment naturally leaned to the new high-capacity continuous miners where seam conditions permitted; otherwise, to the new super-high capacity conventional cutting and loading machines. Since the coal seams lay in ridges and points of considerable outcropping, the decision was to keep the transportation on the surface and mine the coal with multiple entries into the outcrop. This way, the major problems of underground haulage, drainage, and ventilation are eliminated, and the opportunity to take advantage of a-c underground power becomes a much simpler proposition.

The individual mines have a minimum of surface facilities which include a portable 80-ton bin and a readily movable fan, a portable transformer bank, and a small mine foreman's office and lamp house on skids. Underground transportation from the mine's interior to the bin on the outside is by a rope sideframe belt conveyor. The rope belt conveyor, has proven itself in underground operations due to its ease of extension and low moving costs as compared to the rigid sideframe conveyor or other methods of continuous haulage underground.

After this coal deposit was determined to be an economical mining operation, it was necessary to select a loading site for transferring coal into railroad cars for transportation to consumers. It was soon shown that a point on the Guyan River, flowing through the valley below, was most desirable for at this location the Virginian Railroad and Norfolk & Western Railroad converged. This factor permitted the transportation of coal on both railroads, one eastbound and one westbound. Unfortunately, at this location, there was almost no room in the valley for a sizeable preparation plant, and with the railroads on one side of the river and a highway on the other, no space whatsoever for refuse disposal.

To compound the problem, the design of a system for transporting coal from the seam levels to the railroad some 1400 ft below had to provide for the following:

1) Raw coal storage to permit two or three days of storage so that the mine could run continuously in the event of mining or market interruptions.

2) A scalping operation whereby the large rock could be scalped off by means of bar screens—a cheaper method of handling than having to separate

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Railroad loading site of Ben Creek No. 2 mine. Virginian Railroad, left; Norfolk & Western, right background.

Coal handling layout at Ben Creek No. 2. Far left, blending facilities; left center, crushing plant; right, coarse and fine coal washing plants and waste disposal area. Railroads lie between washing plants, on a ridge, and the river below.

and dispose of the large rock within the preparation plant.

3) A coarse coal cleaning plant to wash the ¼ x 6-in. coal by heavy-media operation.

4) A fine coal cleaning plant for the ¼-in. x 0 coal.

5) A storage facility for the ¼-in. x 0 coal screened out of the raw run-of-mine coal so that the fine coal plant could be run independently of the coarse coal plant. With the wide range and fluctuation of coal size from the seams— particularly with continuous mining—storage facilities were necessary to permit the fine coal plant to run two shifts or more continuously, irrespective of the feed to the coarse coal plant and raw coal screens.

6) Storage space for both coarse coal and fine coal refuse, allowing for the fact that the seams contain up to 45 pct rejects.

7) A clean coal screening and sizing plant with facilities for loading at least four sizes of coal on each of the two railroads.

CONVEYOR SYSTEM

Rather than attempt to place all of the above facilities in a single coal preparation plant located on the railroad, it was decided to locate each of these facilities at natural points along the route between the seam level and the railroads, taking advantage of gravity for moving the coal wherever possible. The hillside offers more ideal locations for coal storage bins, location of refuse piles, and plant sites because the good rock subsurface eliminated costly concrete foundations for the heavy preparation machinery. Inasmuch as wire-rope suspended belt conveyors have proved to represent a great saving over rigid belt structure in some underground installation costs, it was decided to connect these facilities together wherever possible with rope belt conveyors both inside and outside the various buildings, taking full advantage of the conveyor's following features:

1) The resilient mounting of each carrying-idler of the conveyor on the wire rope enables this type of conveyor to convey higher capacities at greater angles against the load and larger lump size with less spillage than corresponding rigid-type conveyors.

2) The conveyors are quite easily and cheaply installed. This ease of installation permitted the conveyors to be strung out on mud sills over rough and undulating ground rather than elevated on rigid trusses with heavy foundations. Where this was impossible, wire ropes were used for supporting the

Coal from other mines is transported on this conveyor from railroad shakeout to cleaning plant (background).

conveyors, forming natural catenaries for smooth vertical curves and greatly simplifying any necessary steelwork. In such cases the conveyor was suspended on bar joists trusses on simple *A* frames, a considerable saving over the conventional conveyor gallery.

3) The ease with which the advantages of graduated idler spacing is accomplished helped insure better support of the load at the low tension points.

4) Belt covers that allow quick and easy access to the idlers and the belt are simply applied to this type unit. These are 10 in length, assembled on the job, and attached to the wire rope in four places.

A ridge 254 ft above the railroad was chosen to be the site of the fine coal and coarse coal preparation plants. The coarse coal plant included heavy-media and raw-coal screening machinery; the fine coal cleaning plant utilized Deister tables, centrifugal driers, vacuum filter, and two flash driers. The entire conveying system consists primarily of the rope belt conveyors but also chain conveyors where the grades were too steep for belting.

A truck dump and receiving bin at the upper elevation discharges vertically into two 1500-ton ground storage bins to provide blending facilities for two or more coal seams; but, more important, to blend the products from continuous mining and conventional mining to a more consistent uniform size. A shaker feeder under each bin automatically feeds the material on to a 30-in. wire rope side-frame belt conveyor which, in turn, discharges into a 420-ft decline chain conveyor operating on a 33° angle in favor of the load. With this system, two different grades of material can either be blended

Conveyor system from blending facilities on crest of hill to storage area and adjacent crushing and scalping plant (lower left). From here, the coal is transported by conveyor (seen in foreground) to the coal washing plant.

Components of the wire rope conveyor system at Ben Creek No. 2 were designed and installed by Long-Airdox Co.

View of the terrain at the site of Ben Creek No. 2 mine. Conveyor belt in foreground is leading to the coal cleaning plants. In left background lies the valley of the Guyan River, where the railroad loading facilities are located.

into one product or, by operating at different times, handled as two separate products.

The decline chain conveyor discharges into another ground storage bin having a capacity of approximately 4000 tons. Further provision is made at this point so that if additional emergency storage be necessary, the raw coal can be handled and stocked out with a bulldozer or end-loader. Material from this bin is again handled by a shaker feeder and loaded on to another wire rope sideframe belt conveyor conveying it down to a scalping and crushing plant where the large rock is scalped off and the coal is crushed to a 6-in. top size. The crushed material is then loaded onto a 36-in. overland wire rope belt conveyor for its 700-ft trip to the raw coal screens located in the coarse coal preparation plant itself.

The two cleaning plants located on the ridge above the railroad track are separated by two 400-ton fine coal silos. Here again, a rope belt conveyor is used to elevate the raw ¼-in. x 0 from the silo feeders into the fine coal cleaning plant.

Since both cleaning plants are located on a ridge, the refuse material is disposed easily. Two 30-in. belt conveyors—one from each plant—are cantilevered over the slope opposite the railroad and discharged into the valley. A settling pond area is provided behind the refuse piles to handle the extremely high-ash underflow from the 3-in. cyclones in the fine coal circuit.

The cleaned coal consisting of ¼-in. x 0 from coal plant and ¼ x 6-in. from the coarse coal plant is lowered separately by the use of two 478-ft decline chain conveyors operating on a down-grade of 28° to the sizing and loading facilities located at railroad level. The grading facilities are located over the Norfolk & Western tracks, and when loading on the Virginian Railroad is desired, then conveyors transport each size to duplicate loading facilities on the Virginian Railroad.

With the cleaning and loading facilities on two railroads, it was decided as an afterthought, that it would be definitely advantageous to bring coal from other properties—particularly the Ben Creek No. 1 operation—via intransit rates to be cleaned at this modern facility. Loaded coal cars are spotted at a car shakeout and unloaded into an 80-ton bin equipped with a shaker feeder. The feeder, in turn, loads a 36-in. 890-ft wire rope sideframe belt conveyor operating on an upgrade angle of 19° elevating the coal some 380 ft back up onto the mountain where it discharges into the coal cleaning plant.

SUMMARY

The use of the wire rope conveyors throughout the system, and to a lesser extent the use of the decline chain conveyors where the grades were too great for rope belt, represented a substantial saving over any other system that could be devised for material handling. By comparison with the rigid structure-type of belt conveyor, a substantial cost advantage is evident based on the cost, for instance, of the overland conveyor that feeds the cleaning plant, a 36-in. rope belt conveyor, 700 ft long, powered by a 30 hp motor, and mounted on mud sills. With this unit, walkways, structural steel supporting members, and extensive grading are substantially eliminated. This unit worked out to a cost in place of approximately $75 per ft. A rigid belt conveyor gallery for the same job was estimated to cost approximately $100 per ft.

The low initial cost and other advantages that have made the rope sideframe construction so popular for underground use have herein proven to even greater advantage for cross-country coal transportation. They not only have greatly simplified and reduced the overall costs of the complete material handling system but also allowed the selection of more ideal sites for the location of the various elements of the coal preparation system.

WAGE INCENTIVES IN UNDERGROUND MINING

A NUGGET OF GOLD . . . . or a pot of ashes?

BORJE O. SAXBERG and ROGER L. WINTER

Some form of wage incentives has been used traditionally in the mining industry to determine miners' pay. However, very little is actually known about the administration of such wage incentive plans in mining. As far as the authors know this is the first time a general examination of wage incentive systems as applied to underground mining has been undertaken.*

This article reports the results of an investigation pertaining to the administration of wage incentive programs for miners who drill, blast, and load—mainly in underground metallic mining operations. This investigation was conducted to obtain management's views and attitudes towards wage incentives; therefore, the results do not necessarily represent accurately the thoughts of the miners themselves nor those of any organized union of miners.

Based on the results of the research reported here, employment of wage incentives in underground mining is regarded as a necessity by mine management to reward miners working under hazards and under conditions peculiar to this industry. However, there appears to be little evidence that mine operators would justify their incentive pay plans on any other basis than tradition.

Questionnaires were mailed to 116 mining concerns with underground mining operations. Of these firms, 111 were located in the United States, and 5 in Canada. The interest attached to the survey is clearly evident from the fact that 59 companies answered, some with extensive comments, for a return percentage of 51 pct:

	Number of Companies	Pct
No response	45	39
Returned without having reached destination	12	10
Response, not applicable (no active underground mine)	11	9
Response, applicable	48	42
Total	116	100

Applicable answers were received from 48 companies with active underground mining operations. These firms ranged in size from those having mines with a daily tonnage of less than 500 tons (11 in number), to those producing more than 3,000 tons (4 in number); all methods of underground mining were represented, from cut and fill stoping to block caving. There appeared to be no correlation between company size or location and the use of wage incentives. Neither do size, location, nor type of mine seem to make any difference as to the *kind* of wage incentive plan in use.

It should be noted that nine respondents to the questionnaire survey reported that they did not use an incentive pay plan in their operations. Most of these mine operators indicated that this was due to conditions underground which do not permit the use of incentive wages. The managements at these mines also cited union opposition as a reason for not having an incentive system. Further, some of the mines

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* A series of papers on wage incentive plans and their mechanics in specific underground mines were presented at the Annual Meeting of the American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., New York, February 14 to 18, 1960. Abstracts of these papers appeared in the December 1959 and January 1960 issues of MINING ENGINEERING.

without wage incentives at the present time had used them in the past. One company responded as follows:

> "We do not presently employ a wage incentive system because the system we did use got out of control, for the miners were asking more and more money for less and less work. Thus, the management abandoned wage incentive systems for miners."

Of the 36 mine operators answering the question on the type of wage incentive plan used, 27 employed a contract or piece rate system, while nine reported that they used some form of bonus or premium plan. Under the contract system, the miners bid a price for a job or they are paid a fixed rate for each cu yd, linear ft, or ton mined. Under a bonus or premium plan, a standard weekly or monthly task is established; whatever the miners turn out in excess of this standard is paid at an additional rate.

DETERMINING WORK STANDARDS

About half of the mines with incentive wage plans charged the mine superintendent with the initiation and installation of standards of performance; only about 20 pct reported that they use industrial engineering personnel for this purpose. In setting standards, many mines rely heavily on the background of experienced mine operators and engineers. This is evident from the fact that more than one-half of the mine operators using incentive wage programs determined performance standards on the basis of past experience only:

Method of Setting Standards	Number of Companies	Pct
Past experience	23	59
Time and motion study	4	10
Method study and past experience combined	9	23
No response	3	8
Total	39	100

Of the mines included in this investigation, 14 reported that standards were subject to continuous review; at the other extreme were six firms reporting that standards were reviewed only when set up. One large mine stated that they had used wage incentives for over 70 years, but their standards were reviewed only to meet increases in wages from year to year. In another large mine basic rates have remained unchanged for several years but an hourly "add-on" increment to the incentive earnings calculated on the basis of the old rates has now reached about $1.50 per hour for the miners in that particular mine. It must be added, though, that several of the mine operators wrote that they were considering introducing time and motion study as a basis for setting work standards.

The returned questionnaires showed that standards in various mines differed in application. One-half of the responding mines used different standards for different work conditions. For example, stope miners working in different stopes would be on a different set of standards due to peculiar stope conditions (hardness of rock, width of stope, etc.). One-third of the mines separated their standards only by specialization. That is, all stope miners worked under the same standards, all drifters worked under the same standards, etc. The remainder of the mines maintained uniform standards for all types of mining.

MINERS' VIEWS ON WAGE INCENTIVES

In the administration of a wage incentive system it goes without saying that the attitudes of the employees working under such a program become extremely important for the success of the plan. There was general agreement among the mine operators that the miners themselves should have full understanding of the wage incentive plan under which their earnings were computed. To this effect mine managements keep the miners informed about details and changes in the system by posting notices, by oral announcement, or both.

Union Attitudes: In underground mining of metallic ores, management apparently is not troubled by interference or opposition from the union in the administration of incentive wage plans. Over 90 pct of the mines covered in the survey stated that their union did not limit the use of wage incentives, though about 20 pct of the responding mines confessed that standards are a source of conflict in union negotiations, as suggested by the following comment from a respondent:

> "The union doesn't know anything different—they always claim that pay is not commensurate with work load and the risk in spite of the fact that they are the highest paid labor in . . . [this area] . . . and the miners here have an excellent safety record."

Where the mines deal with a union (eight companies did not have a union) the wage incentive plan is subject to a certain amount of union control since 50 pct of these mines indicated that union agreement is necessary in changing or installing a wage incentive system:

Union Involvement	Installation Number of Companies	Installation Pct	Change Number of Companies	Change Pct
No agreement	19	64	16	52
Agreement necessary	11	36	14	48
Total	30	100	30	100

Miners' Reactions: Even though all but one of the responding mine operators expressed the feeling that their workers' attitude in general is favorable to incentive wages, a closer examination of the questionnaire response reveals some weak spots. For instance, where non-incentive employees work together with incentive earners, mine operators concede that some resentment may exist among the hourly wage earners due to the higher earnings possible under a wage incentive plan:

Non-Incentive Employee Attitude toward Incentive Earners	Number of Companies	Pct
No resentment	23	59
Resentment	5	13
Possible resentment	3	8
Resentment not observed	6	15
No response	2	5
Total	39	100

An example of this was offered by one mine engineer as follows:

> "There was cause for a lot of hard feeling for only about ten pct of the total employment was on contract. One instance was the sabotaging of the crusher so that the contract muck crew couldn't haul any more muck. This was done by the clever system of throwing a few boxes of ball bearings into the muck cars. When the ore came out of the primary crusher it would pass on a conveyor belt under a magnet. This magnet would stop the belt so that a man would have to dig out the ball bearings. These bearings would be on the belt at a distance of ten ft apart with the muck one ft deep by four ft wide. This practically stopped the crusher for the whole time that any bearings were in the muck."

The majority of mine operators is in agreement that there is no resentment, or that at least none has been observed among their employees. The same holds true in the case of possible resentment among incentive pay earners as a result of their differences in earnings, but possible resentment is also recognized here:

Attitudes among Incentive Earners	Number of Companies	Pct
No resentment	22	56
Resentment	8	20
Possible resentment	1	3
Resentment not observed	5	13
No response	3	8
Total	39	100

As indicated previously, all but one of 36 responding mines indicated that miners were favorably disposed to incentive wages. Apparently this can be traced to the possibility of increased take-home pay under an incentive pay program. Underground mine managements reported widely varying figures for this increased take-home pay as shown in Table I. There seems to be fairly strong agreement that the incentive wage earners are able to exceed the time rates by approximately 40 pct.

In spite of the amicable relationship generally existing between union and mine management, and between miners and mine operators, as far as wage incentive are concerned, it is significant that about one-half of the respondents in the final analysis agreed that employees sometimes restrict or "peg" their output. Mine operators suggested that this was mainly due to fear of a potential tightening of standards by management rather than from possible resentment from fellow workers.

MANAGEMENT'S VIEWS ON WAGE INCENTIVES

Practically all the respondents intend to continue their present wage incentive programs. Much of this satisfactions with wage incentive programs in underground mining apparently can be related to management's belief that unit costs decrease as a result of employing some form of wage incentive program. The estimated decrease in unit costs varies from mine to mine but approximates 15 pct (Table II). Similarly mine management estimates that output under a wage incentive system increases by about the same or slightly greater amounts as shown in Table III.

It should be mentioned that *few* mine operators know the exact figures; no less than 13 mine operators stated specifically that they have been on incentives for so long that they have no firm basis on which to compare unit costs and output with or without wage incentives. This is also reflected in comments such as these:

> "It . . . [an increase or decrease in unit costs] . . . is impossible for us to determine, as the program was put into effect when the mine was started—we are quite sure if the program were discontinued our costs would increase, but what per cent we do not know."

> "Since incentives have been used for 40 years we have no accurate comparison. An estimate is that skills are 20 pct better but that contract negotiations have gained 10 pct of the cost for the miners."

Other advantages under a wage incentive system from the point of view of mine management include reduced need for men due to a more efficient workforce and its greater stability in times of high turnover; inducing miners to work in areas where working conditions are poor or dangerous; speeding up of developmental work; initiation and application by miners of new and more efficient ways of doing work to increase production and thereby their earnings; and better care of equipment by the miners who also are under pressure to plan ahead in order to maximize their daily earnings. Probably one of the most important advantages mentioned concerned the reduced need for supervision.

Table I. Estimated Increase In Miners' Pay Due To Wage Incentive Plan

Item	Work Area: Stope	Drift	Raise	Shaft
Basis	%	%	%	%
Range	4-100	10-100	10-135	10-161
Mean	37	44	46	57
Median	28	38	40	46
Number of Mines Reporting	27	30	28	18

Table II. Decrease In Unit Costs Under Wage Incentives

Pct Decrease	Number of Companies	Pct
0	1	3
1-5	2	5
6-15	10	25
16-25	7	18
26-35	3	8
36-50	0	0
51 and over	1	3
No response	15	38
Total	39	100

Table III. Increase In Output Under Wage Incentives

Pct Increase	Number of Companies	Pct
0	1	3
1-5	1	3
6-15	7	17
16-25	5	13
26-35	4	10
36-50	2	5
51-75	1	3
76 and over	1	3
No response	17	43
Total	39	100

Though the mine operators covered in this investigation feel that the advantages outweigh the disadvantages of incentive wages, mine management is not blind to weaknesses inherent in such systems. Incentive pay plans give rise to grievances over prices and personnel; the whole plan may become subject to controversy with the workforce. This is also illustrated in comments supplied by spokesmen for two mines:

> "Incentives tend to produce a class of *prima donnas*. The remainder of the work force plugs along without much incentive to turn out any more than what is required."

> "The boys are happy one period and unhappy the next as the contract earnings are posted."

Mine operators also recognize the temptation among some miners to resort to fraudulent practices to maximize their earnings. In one mine it is reported that it was a common practice to buy off the shifter. A box of cigars once a week would increase the

miners' pay by about 10 pct, for the shifter who did the measuring would give the miners more volume and a greater number of rock bolts than they deserved. Or a contract miner may force management to put him on a day's pay as he has foreseen a "bad day." This practice prevents a poor day's production from affecting a good day's output. Dilution of ore may also occur, as suggested by the following comment which the authors received:

> "We mine in narrow veins (8 to 12 ft wide) and dilution under the cubic system must be watched and is very often abused."

On the whole the majority of mine operators is not convinced that fraudulent practices form a serious problem:

Fradulent Practices; Occurrence	Number of Companies	Pct
None	22	57
Seldom	9	23
Often	4	10
No response	4	10
Total	39	100

Close to 35 pct of the respondents indicated that there is a possibility that miners sacrifice safety to increase their output under a wage incentive plan:

Miners' Concern for Safety	Number of Companies	Pct
Miners do not sacrifice safety	21	54
Miners do sacrifice safety	13	33
Not observed	2	5
No response	3	8
Total	39	100

Sometimes the miners will carry blasting powder to their work place and hide it at the beginning of the shift rather than wait to check it out until needed as required by mine regulations. If the incentive rates are greater for the amount of rock broken than for supports to hold the walls and back, the miners may try to slide by with a minimum of supports. However, the great majority of the mine operators participating in the study strongly reflects the feeling that it is up to management not to tolerate shortcuts to safety.

Other disadvantages of incentive wage systems cited in the response to the questionnaires include the cost of administering and maintaining the program, tendencies to raise all wage levels, and difficulties attached to changing rates which are excessive—some contract miners have been able to earn more than their shifters or foremen. In addition, workmanship is sometimes sacrificed in contracting; favoritism is occasionally shown by some foremen in making adjustments in contract rates; and "some men tend to overwork," which other workers may feel to be a threat by fostering increased work standards.

WAGE INCENTIVES—A NECESSITY IN UNDERGROUND MINING

The results reported here concerning the administration of wage incentive plans in underground mining are interesting in themselves as a reflection of industry practices in this field. Wage incentives apparently are regarded as a necessity by operators to gain lower unit costs. In part this comes about because of the miner's isolation, requiring self-reliance and independence; he and his partners are placed in work areas apart from the rest of the crew, thus making supervision difficult. In addition, mine managements believe that a reward must be paid to employees working under the hazards inherent in underground operations. Increasing a daily wage would be one way, but according to the mine operators, the miners themselves prefer the chance to earn more than a normal day's wage.

NEED FOR RE-EXAMINATION OF CURRENT WAGE INCENTIVE PLANS

Another set of conclusions appears to the authors to be more crucial. Wage incentives in underground mining are used as a matter of routine reflecting a historical tradition without further investigation or justification for their present use. This was evident when mine operators were asked how the incentive system had changed unit costs; more than one-third reported that they had been on incentives so long that they did not know what effect, if any, it had on unit costs.

It is significant that a few large mines are attempting only now to restudy and reset their work standards, using formal time and motion study work for the first time. Many mines apparently need to reconsider their use of specialized personnel for the continued maintenance of a good wage incentive program. It is the authors' contention that records of past experience are important and needed in the definition of standards of performance, but these form only the beginning of a scientific study to set a basis for a wage incentive program. On-the-job studies, supplemented by time and motion study should follow. It is therefore important that management charged with the responsibility for setting standards be thoroughly trained in the techniques or have recourse to a trained staff.

Temporary standards cannot be set up with the idea of changing them later; some of the successful users of wage incentives said that once the standards are set, they are never changed except for a major development, such as the introduction of new equipment or new mining methods.

CONCLUSIONS

The results of this investigation appear to reflect mine management's recognition of physical or economic incentives as the only means whereby productive output can be maintained or improved in underground mining. Therefore, a more provocative question is whether mine management has been alert to the developments in industrial management within the last 50 years which have indicated that physical or economic incentives form only part of the workers' motivation in an economy where the basic needs for the majority have long ago been met. Rather than reliance on a traditional incentive wage system to keep miners producing, the need for effective and competent supervision comes sharply into focus.

To the authors there is a hollow sound today in the suggestion that a man should stake his life in underground mining operations because of the incentive wage attached to the work. For the old generation of miners this may do, but it is doubtful whether a new generation of miners will accept such an outlook at the expense of sound and safe working conditions.

Though the authors conclude on the basis of the study reported here that mine operators regard incentive wages as an indispensable tool in achieving desirable levels of output in underground mining, a word of warning is needed. The amount of effort in planning and maintaining a wage incentive program will determine whether the wage incentive plan rules management or management rules the plan.

IRON DEPOSITS OF WABUSH LAKE, LABRADOR

by R. D. MACDONALD

The search for metalliferrous deposits in the Labrador-Ungava Trough of Canada dates from 1929 when non-ferrous minerals were the main quest of prospectors in this area. Many gossans, resulting from the oxidation of sulfides, were located and examined but none of these led to any orebodies of commercial value. However, such investigations did much to arouse interest in this area and fostered further mapping and prospecting. Since this early period in the history of prospecting in the Trough, the presence of iron ore deposits and potential iron producing sites has commanded the center of attention of exploration personnel.

The iron-bearing rocks of southwestern Labrador have in recent years come into prominence as possible sources of iron ore of the beneficiation type. Exploration and development work has been carried on in concession areas granted by the Newfoundland Government to the Labrador Mining and Exploration Co. Ltd. and to the Newfoundland and Labrador Corp. In the course of evaluating its holdings in the Wabush Lake area (Fig. 1), Labrador Mining and Exploration Co. has conducted geological, geophysical and diamond drilling programs.

HISTORY OF EXPLORATION

Labrador Mining and Exploration Co. was formed in 1936 to prospect a concession of approximately 20,000 sq miles obtained from the Newfoundland government. Hollinger Consolidated Gold Mines Ltd. obtained control of the company in 1941 and initiated an expanded program of exploration for ferrous and non-ferrous minerals.[1] Following the successful location and proving of more than 300 million tons of direct shipping iron ore, the Iron Ore Co. of Canada was formed in 1949 to exploit the orebodies on a sublease arrangement. As part of this agreement Iron Ore Co. was granted the right to sublease two-thirds of the ore in selected areas of the Wabush Lake region.

Iron-bearing formations were first located in this area during 1933 when J. E. Gill[2] investigated the area for reported gold occurrences. Labrador Mining and Exploration Co. began systematic exploration in the region during 1949, and in one season disclosed the presence of extensive areas of metamorphosed iron formation containing concentrations of magnetite and specularite. This work led in turn to more extensive and detailed work designed to locate and evaluate all iron-bearing formations within the southwestern portion of the concession. In 1958 Iron Ore Co. decided to proceed with the major construction program that is still underway with the intent of mining and concentrating the ore from one of the major bodies of the Carol Lake-Wabush Lake district.

GENERAL GEOLOGY AND STRATIGRAPHY

The iron formation of the Wabush Lake area is considered to be the southern, but more highly metamorphosed, extension of the iron formation of the Labrador-Ungava Trough. The distribution of

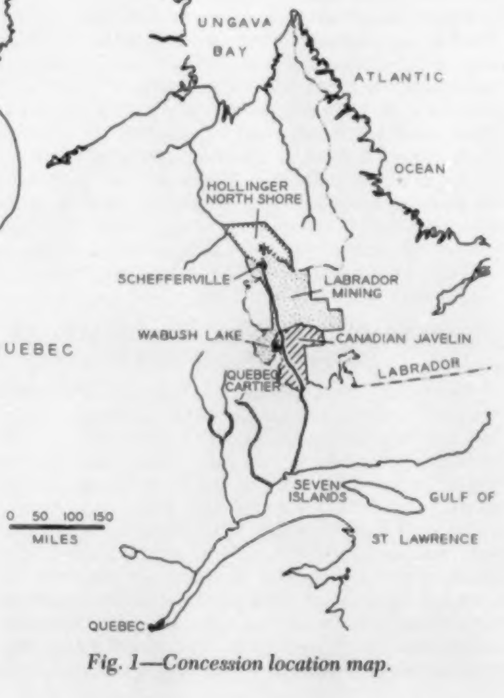

Fig. 1—Concession location map.

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the iron belts is shown in Fig. 2, this being a generalization of an airborne magnetic survey.

The iron formation of the main portion of the Labrador-Ungava Trough is essentially unmetamorphosed.[3] In the region of Sawbill Lake the iron formation and associated rocks change from unmetamorphosed rocks on the north to regionally metamorphosed rocks on the south. The exact nature of the zone or line of change is not known since the area of critical interest is drift-covered. It is generally considered, however, to represent a portion of the Grenville Front where it transects the Labrador geosyncline. The iron-bearing rocks to the south of this zone are not only more highly metamorphosed, but have been more intensely folded, faulted and sheared so that they now form discontinuous and disrupted masses.

The stratigraphic terminology used for the rock types of the Wabush Lake area within the concession of the Labrador Mining and Exploration Co. is shown on page 1102. Correlations have been made with the rocks of the iron belt at Schefferville but because of the metamorphosed nature of the rocks in the Wabush area, the correlations are necessarily generalized. There is little doubt, however, that the Wabush formation correlates with the unmetamorphosed Sokoman formation to the north. There are many lithologic similarities between the formations of the two areas, and there are no other rocks within the region with which a confusion in correlation could be made.

The Wabush iron formation lies within a sequence of metamorphosed sedimentary rocks consisting of quartzite and a complex of schists and gneisses. Crystalline limestone is present in areas to the east and south but is not involved in the sequence of the Carol Lake-Wabush Lake area. It has been given the name Duley formation and is considered to be pre-Carol and post-Katsao in age.

A rock that has been variously termed amphibolite, garnetiferous quartz-hornblende gneiss, or altered gabbro, occurs in close association with some orebodies and gabbro intrusives. It is typically gneissic in texture and contains black amphibole, quartz, feldspar and pink garnet. It is considered to be an original quartzose chlorite schist that has been metamorphosed by the intruding gabbro and by dynamic action. In its occurrence at the Wabush No. 3 deposit (Fig. 3), it is considered to be younger than the iron formation and to be a member of the Nault formation.

In addition to gabbro, diorite and related basic igneous rocks also intrude the stratigraphic rocks of the area. They are typically massive but their border phases may be gneissic to schistose. The youngest Precambrian rocks are granites, granite gneisses and related types. They occur most commonly to the west of the Carol Lake-Wabush Lake region.

DESCRIPTION OF THE IRON FORMATION

The iron formation includes all iron-oxide, iron-silicate and iron-carbonate rocks plus certain amphibole-pyroxene schists and gneisses that lie stratigraphically within the iron members. D. M. Knowles and R. G. Gastil[4] have described the iron formations on a facies basis as consisting of a carbonate member, a silicate-carbonate member, and an oxide member. This concept can be applied to the Carol Lake-Wabush Lake area. The sequence, with reversals caused by changes in depositional environment, is generally from the carbonate member at the base, through the silicate-carbonate member to the oxide member at the top.

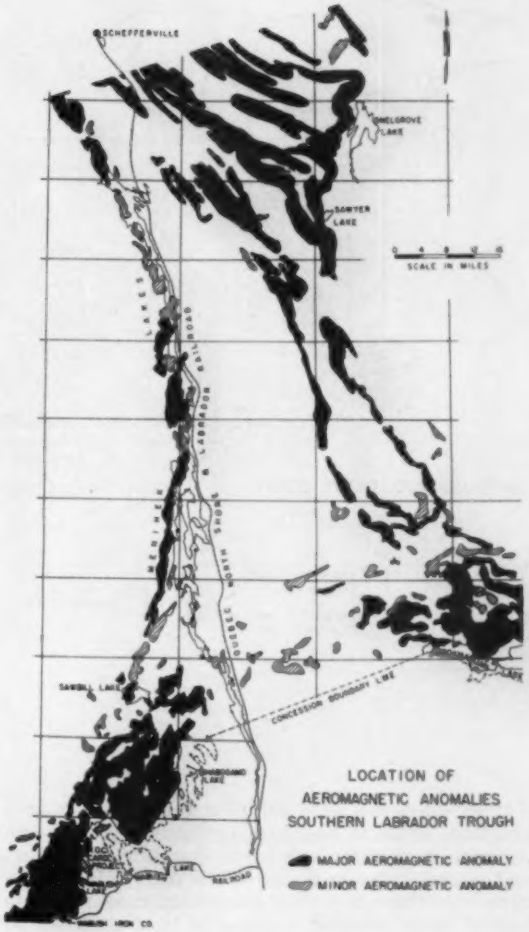

Fig. 2

The oxide member is characterized in a general way by a lower magnetite-rich zone and an upper specularite-rich zone. The basal portion of the member is evidently gradational from the silicate member since grunerite and magnetite occur together in a narrow zone below the main oxide zone.

All members are not necessarily present in any particular locality, and each member varies considerably in thickness from one place to another. In the area under discussion the carbonate, the carbonate-silicate, and the magnetite-grunerite members are less than 200 ft thick whereas the oxide member reaches thicknesses of 400 to 500 ft.

The oxide member is usually simple in its mineral content. Granular quartz, specularite and magnetite make up the greatest proportion of the rock. Minor to accessory amounts of limonite, iron carbonate, grunerite and amphibole occur irregularly. The member is typically granular but in the case of varieties high in specularite, a platy to schistose texture may be developed.

EXPLORATION METHODS

The exploration stage prior to 1945 indicated the presence of an appreciable tonnage of iron ore at

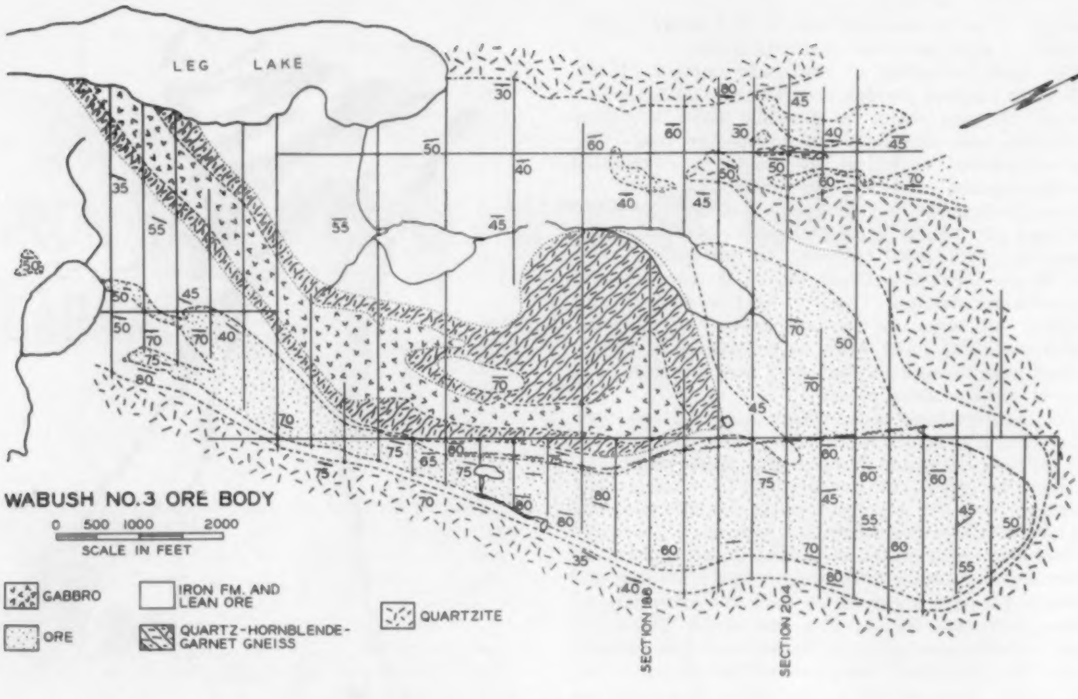

Fig. 3

a time when the need for new reserves became a pressing factor in the iron ore industry of North America. A decision was made therefore, to step up and intensify the program of ore search. It became apparent that the semi-reconnaissance mapping backed up by detailed mapping in local areas would not be sufficient to explore the iron belt properly. Large areas extending out from the known ore bodies were mapped by planetable methods at a scale of 1:2400. An extensive mapping program at a scale of 1:12,000 designed to cover all areas underlain by iron formation, was started in 1949 and carried through to 1952.

The ore bodies found during the pre-1945 period required intensive work. Detailed mapping and test-pitting was begun. The surface limits of many of the ore bodies were extended and several new deposits were located in drift-covered areas.

In order to obtain information on the depth to which the ore might extend, drilling was begun in 1946. This program was expanded during the following years and continued through the development stages of various ore bodies.

During the period of intensive exploration a variety of geophysical methods were used to locate ore bodies. An airborne magnetic survey was flown in 1951 to locate all iron formation bands. Ground magnetometer and gravimetric surveys were made in 1947, 1948 and 1950 and these were followed up by trenching, test-pitting and drilling in drift-covered areas.

Wabush Area Exploration: As a part of the systematic investigation of the concession, geological mapping at a scale of 1:31,680 was started in the Wabush area in 1949. Geological work was accomplished by pace and compass traverses which were tied into prominent topographic features by compass resection methods. When air photographs became available one year later, the information was compiled on maps drafted from photo mosaics. During the course of the first season, six interesting zones of magnetite and specularite were located and mapped at a scale of 1:2400. Sampling and subsequent ore testing confirmed the presence of major tonnages of readily concentratable ore grading about 40 pct Fe.

On the basis of the ore potential shown by the 1949 mapping, an airborne magnetic survey was flown over the iron belt in 1951. The survey successfully outlined the iron formations and served as a control for further 1:12,000 scale mapping. This type of mapping was carried on over the period 1952 to 1957 and, in some of the more interesting localities, at a scale of 1:2400.

A second major step in exploration methods was taken by Iron Ore Co. in 1956. A systematic program of diamond drilling was begun in drift-covered areas. Exploratory drill holes were put down on section lines to test areas for possible ore occurrences. Approximately 42 sq miles were covered during 1956, 1957, and 1958.

A third development in methods of search for iron bodies was taken by Labrador Mining and Exploration Co. in 1958. This consisted of traversing iron formation belts with combined magnetic and gravimetric methods. The decision to do this work was based on the fact that, whereas magnetic methods could be relied upon to locate magnetic zones, they would not indicate high specularite–low magnetite bodies. Furthermore, certain zones of specularite-magnetite ore might contain narrow magnetic bands that would show magnetically with no indi-

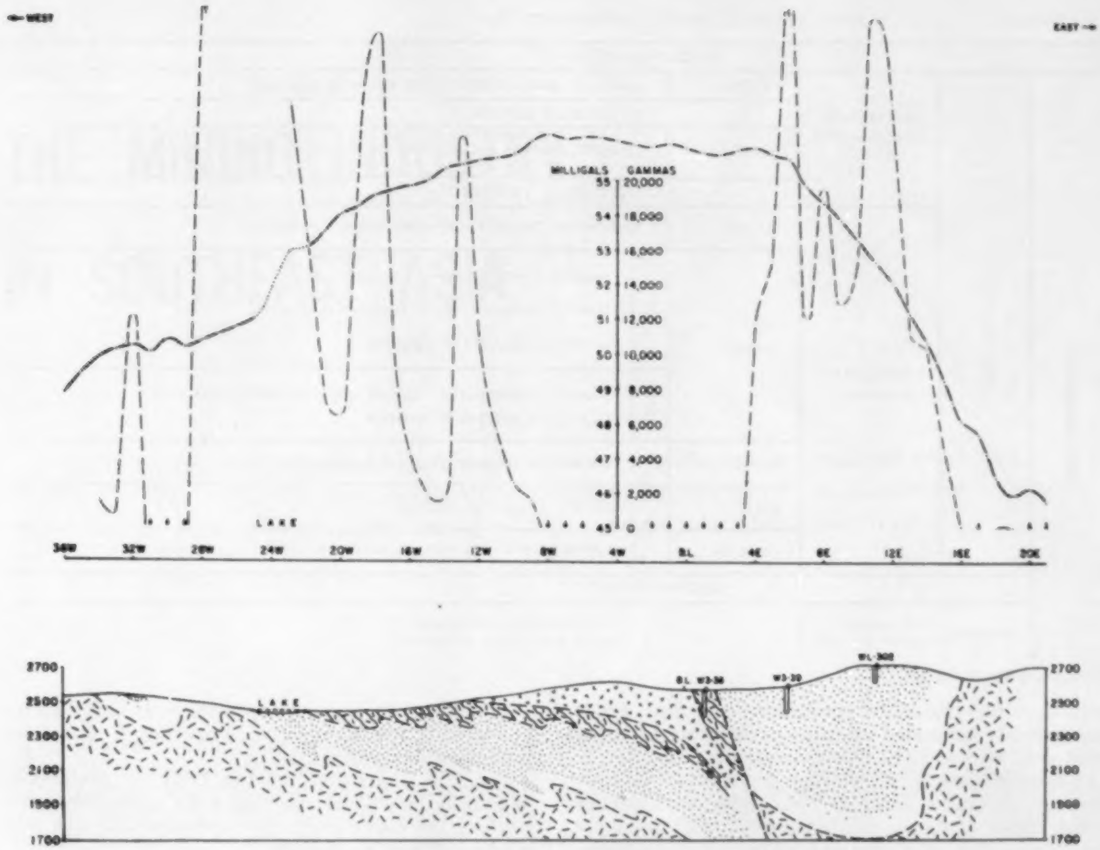

Fig. 4—Gravimetric and geological profile of Section 188 at Wabush No. 3.

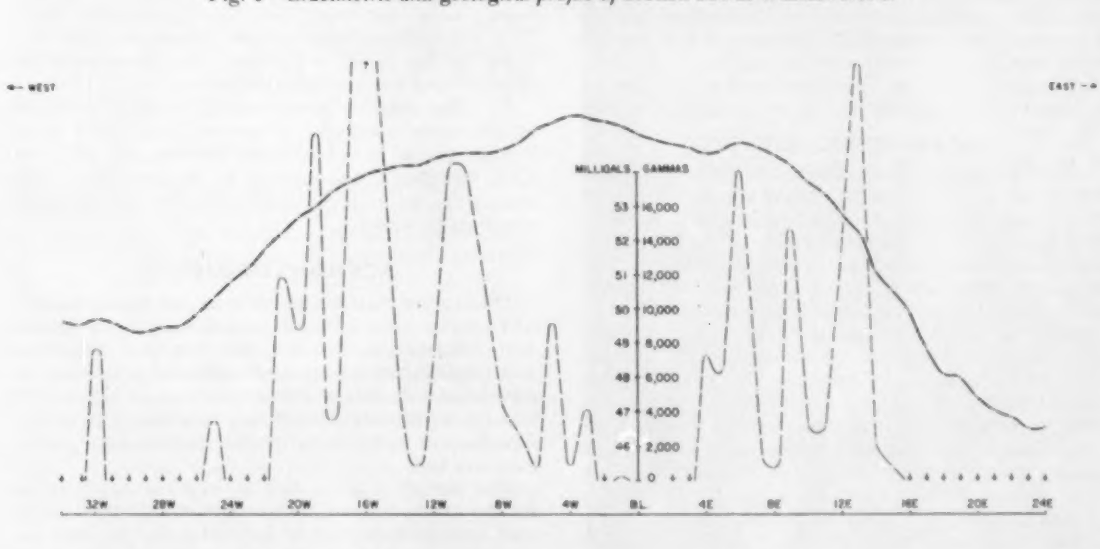

Fig. 5—Gravimetric and geological profile of Section 204 at Wabush No. 3.

CENOZOIC					GLACIAL DEPOSITS, LAKE AND STREAM DEPOSITS
UNCONFORMITY					
PRECAMBRIAN	PROTEOZOIC	MONTAGNAIS (KEWEENAWAN TYPE)	SAWBILL		GRANITE, GRANODIORITE AND RELATED GNEISSES
			INTRUSIVE CONTACT		
			SHABOGAMO		GABBRO, DIORITE AND RELATED BASIC INTRUSIVES
			INTRUSIVE CONTACT		
		KANIAPISKAU (HURONIAN-?)	NAULT		GRAPHITIC, CHLORITIC AND MICACEOUS SCHISTS
			WABUSH	UPPER	QUARTZ - SPECULARITE MEMBER QUARTZ - MAGNETITE - SPECULARITE MEMBER QUARTZ - MAGNETITE MEMBER
				LOWER	QUARTZ - CARBONATE - MAGNETITE - GRUNERITE MEMBER QUARTZ - CARBONATE MEMBER
			CAROL		QUARTZITE, GARNETIFEROUS QUARTZITE
			DULEY		IMPURE DOLOMITE, MARBLE
			KATSAO		GARNET, BIOTITE, HORNBLENDE SCHISTS AND GNEISSES
	UNCONFORMITY				
	ARCHEAN	ASHUANIPI COMPLEX			ORTHOGNEISS, PARAGNEISS ACID AND BASIC INTRUSIVES

cation of the associated specularite ore. Such zones could easily be passed up in an exploration program that must necessarily cover extensive areas.

Preliminary gravimetric test work was run over known ore bodies in 1958. Two gravimetric parties were operated on an exploration basis during 1959 and more than 5200 stations were read. The value of the method is pointed out by the fact that a large-size specularite body was located within the first month of field work. No outcrops occur over the body and the magnetics alone would not have justified drilling the area. The find can therefore be attributed to the application of gravimetric methods.

GRAVIMETRIC SURVEYS

Field Methods: Gravimetric and magnetic readings were taken at 100 ft centers along picket lines that were tied to known topographic features. Warden gravity meters and radar or Arvella magnetometers were used to obtain gravimetric and magnetic information at the same stations. Elevations were obtained by using Paulin altimeters in an attempt to speed up operations in topographically rugged areas. Accuracy to within two ft was obtained by check control methods, this being considered sufficient to meet the requirements of the survey. No measurements for overburden depths were taken since gravimetric variations that could be caused by differences in depths of overburden in most areas were not considered to be sufficiently important to obliterate the target being sought.

Results: In addition to the many exploration lines run during the season, a gravimetric survey was run over one of the known bodies of the Carol Lake-Wabush Lake area (the Wabush No. 3) to act as a guide for a proposed drilling program. Fig. 3 shows a generalized geological map of this body, Fig. 4 shows a profile of Section 188, and Fig. 5, a profile of Section 204. The correspondence between the gravimetric profiles and the geological information is readily apparent.

The value of the gravimetric methods to the interpretation of the Wabush No. 3 orebody is shown by the following points:

1) The dimensions of the body as previously known by geological mapping were extended to the west by the gravimetric interpretation and this was later confirmed by drilling.

2) Probable minimum 600-ft depths for the orebody were indicated by the gravimetric data. This was substantiated by the subsequent drill program to the extent that two holes penetrated 500 ft of ore and were terminated in ore.

3) The possible occurrence of a major extension of ore under a capping of gabbro and quartz hornblende gneiss is indicated in Section 188 (Fig. 4). This interpretation appears to be the only ready means of explaining the gravimetric and magnetic readings obtained.

ACKNOWLEDGMENTS

The author has drawn extensively from the files of Iron Ore Co. of Canada and the Labrador Mining and Exploration Co. for the regional geological and geophysical information. Detailed geological information was obtained from maps compiled by Iron Ore Co. Interpretations of magnetic and gravimetric information were done by the Sulmac Exploration Services Ltd.

The writer wishes also to express appreciation for the assistance and encouragement afforded by the staff and management of Labrador Mining and Exploration Co. Ltd. in the preparation of this paper.

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THE MINING INDUSTRY IN SOUTHEAST ASIA

What problems hinder the growth of mineral production in Southeast Asia? The author discusses some of the hindering factors which are formidable barriers to increased mining in this important area of the Free World.

by D. F. COOLBAUGH

Asia, the largest and most populous continent, has had little political influence on world affairs until very recently. The picture is rapidly changing. Although the cultures of various Asian countries differ widely, today they are united in their desire to industrialize. This desire is the key for expansion of Asian mineral production.

The following discussion deals primarily with the situation in the south and southeast Asian countries —India, Pakistan, Burma, Thailand, Cambodia, Laos, South Vietnam, Malaya, and Indonesia.

THE PAST

In the past the south and southeast Asian countries have not been known for large production of minerals except for tin, tungsten, and manganese. However, many different minerals have been produced in small quantities.

Known ore reserves of most minerals are fairly meager and past production has been small. This can be directly attributed to superficial exploration, to the lack of adequate transportation, skilled labor, long-range planning, a ready and stable competitive market, and largely to the philosophy illustrated by one government official who stated, "There have been tendencies to work high-grade raw material to gain, as early as possible, a return on the investment. The investments in most cases are made restrictedly because initial prospecting and mineral development does not aim at proving reserves. It usually aims at producing minerals which can be easily marketed within the country or in a ready export market." This condition of fast gain is not unique but here it has long been the general practice.

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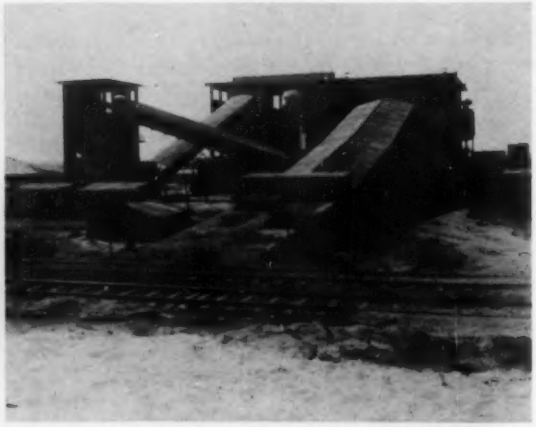
The Kandri open pit mine in India as seen in 1953. This mine is located on one of several manganese-producing properties lying within the Central Provinces of India.



View of coal washing plant located at Dungarpur, India.

THE PRESENT

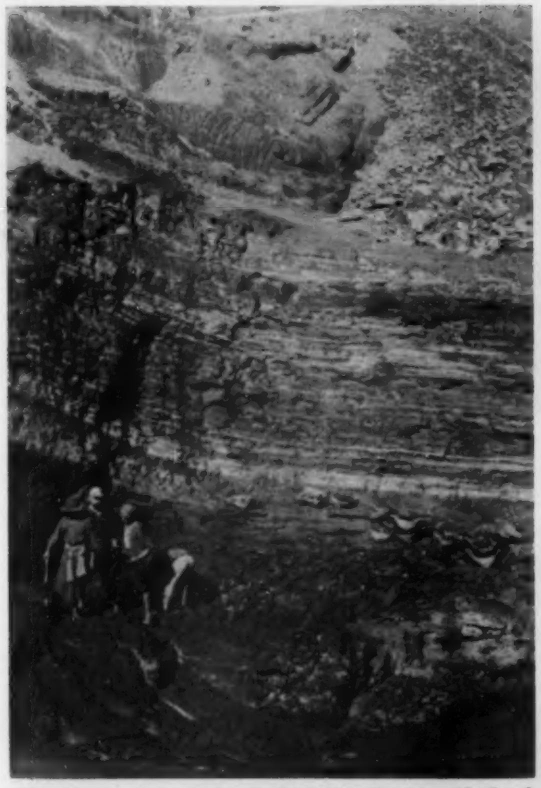
Present production of minerals is very small—exceedingly small on a per capita basis. A survey will show what changes are taking place and how these changes will affect future policies and conditions of the mineral industry in this area.

A glance at the countries comprising south and southeast Asia reveals the diversity of languages, religions, and cultures. On the other hand, all these countries can be listed as industrially underdeveloped; all have a great desire to industrialize; and all, except Thailand, have gained independence within the last 12 years. This newly won independence is a most important factor, for it has been followed by insurrection and rebellion, unstable and inexperienced government, and sanctions against foreign holdings and investments.

Labor: Although local conditions may vary, it can be stated that all these countries have a vast reservoir of unskilled labor available for mining but a shortage of skilled labor. In the past the skilled labor came from more developed countries. It takes generations to develop skilled labor and professional workers from the indigenous labor force. Estimates about the rate of development of a skilled native labor force vary widely from country to country and even between the government and private and educational sources within a country. It is the general feeling from private sources that skilled labor is not being developed in quantity or quality to meet future needs. On the other hand, government officials, including those in education, feel that a shortage of skilled labor exists but that skilled labor will soon be adequate to meet the demands. Some government officials report adequate skilled labor for the mining industry, inasmuch as the mining methods used do not require skilled labor. Such a statement gives some insight into the philosophy of a large segment of government officials. This estimate of an adequate skilled labor force is apparently based on the training of mining engineers and mining technicians and does not take into account the many years of experience needed after formal education is completed.

Power: Cheap power is important to development of the mining industry in any country, but all coun-

This photograph was taken recently at one of the many tin open pit mining operations in Malaya. The world's single richest tin-producing area lies in the Kinta Valley, located near Kuala Lumpur, capital of the Federation of Malaya.



Men digging lignite from the Mah Moh pit in Thailand.

tries under discussion report a lack of cheap power. However, the opinion of many government officials is that there is no lack of power for a mining industry, since mining is carried out by manual labor. Development of electric power is progressing in all these countries, although little is geared directly to mining needs. Two of these countries report that plans for developing aluminum production are underway. The execution of these plans is dependent on power requirements, since substantial raw materials are already available.

Transportation: All countries report that their mining industries are not advancing as rapidly as they should owing to a lack of adequate transportation. Some projects are underway to alleviate this situation.

Financing: The problem of financing mining ventures in these countries is of paramount importance. Before independence, financing was generally obtained through private sources in the mother country. With independence came the logical desire to exploit the riches of each country by and for the benefit of the nationals. To accomplish this, laws were enacted which curbed or eliminated participation by foreigners. As the laws have become more discriminatory against foreign holdings, the financing of new undertakings or refinancing of operating concerns has dwindled to the point where governments have found it necessary to enter into mining ventures. In most instances this has tended to form unfair competition for private operators.

Marketing: The most important single condition affecting the past, present, and future of the mining industries in these countries is that of available markets.

In the past the lack of local industries has meant that almost all production of minerals, other than gold and construction materials, has had only an export market. Distance from potential consumers has been a formidable barrier in competing successfully with ores located nearer the industrial nations of Europe and America. The lack of a strong local market has restricted exploration and production to high-grade bodies of the easily marketed materials.

Before the countries were granted independence, most of their mineral production was sold in the mother country under preferential agreements. Today, economic considerations and strained relationships between these former partners have limited or cancelled these outlets.

Japan, the only industrialized nation in Asia, has been and is actively searching for and arranging to buy mineral raw materials from this part of the world.

MINERAL POTENTIAL

Iron and Steel: India has large iron ore and coking coal reserves and is expanding her iron and steel production. Malaya exports iron ore and South Vietnam reports coking coal reserves. Most remaining countries have reported iron ore occurrences but, since little exploration work has been done, reserves are unknown. Meager coking coal reserves in these countries greatly hamper the development of local steel manufacturing.

One of these countries has a steel mill which was constructed by its government with no raw material supply other than discarded and rusting war equipment that littered the country side after World War II.

Tin: Large supplies and fair reserves are known in Malaya. There is production and limited known reserves in Indonesia, Thailand, and Burma.

Tungsten: There are fair to large known reserves in Burma, Malaya, and Thailand.

Manganese: Large reserves are known in India and there has been past production in Indonesia.

Aluminum: Bauxite is known to occur in most of these countries. Exploration has not been extensive for lack of markets but large deposits are known to exist in Indonesia and India.

Under the hats are dulang washers panning for tin in Malaya. This type of mining accounts for approximately two pct of that country's annual production of tin ore. In Malaya, only women are allowed to mine tin in this manner. The wooden bowl which the women use is called a "dulang", from whence their name is derived.

View of another open-pit tin mine in Malaya. At this particular site, the ore is blasted and loaded on to the conveyor belt in the pit which transports the material from the mine to a nearby treatment plant. In addition to panning and the dry type of excavating shown above, dredging and hydraulic mining are very conspicuous in Malayan tin production.

Nickel: Unknown millions of tons of totally undeveloped lateritic nickel exist in areas of Borneo and Indonesia.

Coal: Coal deposits are scattered over these Asian countries, but coking coal is not in large supply. Most of the coal is of Tertiary origin and generally of poor quality.

Other: Only high grade base metal deposits have been exploited. Most of the common alloy metals exist in this area but in entirely unknown quantities. Radioactive minerals have been found, but there has been no production. Exploration for rare earths and the "new" metals has been almost nonexistent. The rapidly depleting Indian gold deposits are the only known large deposits in this area. Phosphate deposits were mined in Cambodia and Vietnam during the Japanese occupation. Minor deposits of many other minerals are known to exist in these Asian countries.

THE FUTURE

In these underdeveloped countries, mineral export could be used as a source of vitally needed foreign exchange. With their recently gained independence and nationalism, these countries have written their laws discriminating against foreign management and consequently against foreign investment. Such laws must be made more liberal if these nations are to compete with other ore producing countries. Stable governments must also evolve from the present unsettled conditions. The alternative to these changes is further cuts in present mineral production, already at a very low level.

Even though the immediate future is bleak, the long range picture of fifteen to twenty years looks much better. The vast numbers of people in Asia are slowly, but very surely, increasing their standards of living and thereby their dependence upon metals. A very slight per capita increase in the use of metals will result in a large overall increase. With this improved standard of living there will be an even greater desire to industrialize which will in turn require the production of raw materials for locally produced minerals.

Japan will continue to produce finished materials to this expanding market and China will need to import many raw materials if it is to fulfill even part of its ambitious plans. India must be considered even if its production is absorbed exclusively by its own vast population. Australia will continue to expand her industry and will need raw materials from this area.

Position of the United States Investor: At this time the discriminatory laws, the distance to markets, and the political instability do not favor investment in mineral production in the countries of South and Southeast Asia. If and when the incentives become more favorable, it might be a wise investor who considers the future potential of the mineral producing industry in these countries.

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Turn the page to find first-hand accounts of this August meeting in Copenhagen, attended by leaders in geology from all parts of the world.

The 1961 Jackling Award

Established in 1953, the Daniel C. Jackling Lecture is an annual invitation address presented by an outstanding man in mining or an allied field who has contributed significantly to the science and practice of mining, geology, or geophysics. The lecturer is awarded a bronze plaque engraved with his name and the Citation. *See page 1111.*

ROCK IN THE BOX

Mining & Exploration Division

21st INTERNATIONAL GEOLOGICAL CONGRESS

Highlights of the Technical Sessions

Geologists from every corner of the globe met in Copenhagen for the 21st International Geological Congress held from August 16 through August 25. Papers presented at the 21 sections covered almost every field of geology. As might be expected in a meeting as comprehensive as this, many of us in the economic geology field felt that not enough papers were devoted to our particular interest.

Among the papers of most direct interest to economic geologists, there were several on carbonatites and numerous papers on uranium and thorium deposits. L. R. Page, in discussing the source of uranium in ore deposits, suggested that a genetic relationship between uranium and mafic and intermediate igneous rocks is strongly indicated. This relationship could, of course, have strong implications in the search for uranium deposits.

Waterfront at Kalundborg, a typical Danish seacoast town which some may recognize.

Case histories of the application of geochemical and geophysical prospecting techniques were presented, as well as results of more theoretical geochemical and geophysical studies. Of particular interest was a paper given by H. Paarma describing the various magnetic methods used in prospecting for and delimiting bodies of iron ore in Finland.

A paper by J. E. Gill described results of recent work, done at McGill University (Canada), which indicate that solid diffusion of sulfides may be important in ore genesis. Other papers on the genesis of ores dealt with mineral zoning of ore deposits, relationships between sulfide-bearing schists and ores, and hydrothermal alteration. The syngenetic viewpoint was much in evidence during discussions of base metal deposits and especially in a review of the Mt. Isa deposit. To this reporter, the main conclusions to be drawn from the discussions of the papers on the genesis of ores are: 1) that although progress is being made, we still have much to learn about the genesis of ore deposits and 2) that not all ore deposits need necessarily be formed by the same processes. The latter point seems to have escaped the notice of some of the more extreme syngeneticists and epigeneticists both!—*H. T. Schassberger.*

The Rathaus (City Hall) facing Copenhagen's main square flanked by the Palace Hotel.

SPECIAL REPORT ON GEOLOGICAL CONFERENCE IN COPENHAGEN

The geologists of the world have been holding international congresses about every four years (with interruptions during the two World Wars) since the 70's. These congresses have contributed greatly to the development of the science through interchange of ideas between geologists of several continents, and particularly because many leaders of geologic thinking have used them as forums for reaching world-wide audiences. The proceedings and transactions have been truly international in scope and language. In addition there have been field excursions to areas of outstanding geological interest, in each case with guides intimately familiar with the local problems. These excursions have given the visiting geologists from other lands opportunities to see the very exposures and outcrops, the critical stopes in important mines, and key sections showing stratigraphy and structure which had been used as illustrations on which to base geological theories and knowledge.

Since World War II there have been four such congresses—in Britain in 1948, in Algiers in 1952, in Mexico in 1956, and now in Copenhagen in 1960. The size of the meetings and the diversity of the field excursions have grown so much that the host country has been faced with major problems in financing and technical manpower.

In this case the five "Nordic countries"—Denmark, Finland, Iceland, Norway, and Sweden—joined together in a combined effort. Copenhagen in Denmark was selected as the meeting place chiefly because of the facilities offered by the University for assembly and meeting rooms, but field excursions before and after the Congress were conducted in each of the participating countries. These included one in Iceland, one in West Greenland, 18 in Norway, 12 in Sweden, 9 in Finland, and 5 in Denmark, in addition to which there were some one-day excursions during the Congress.

About 2500 geologists attended the Congress. Since many brought their wives, and some their families, the total number that came to Copenhagen during that ten-day period was close to 4000. About 750 of the participants were from the U.S., but 50 countries were represented and their delegates took active part in the meetings. Red China was the only large country not represented. It was a pleasure to see scientists from countries with very different political views getting along well and taking mutual part in scientific discussions.

The technical programs were divided into 21 groups, including a wide range of geological subjects. The only important field not covered at all was petroleum geology, although of course many stratigraphic and structural problems were of interest to petroleum geologists, many of whom were in attendance.

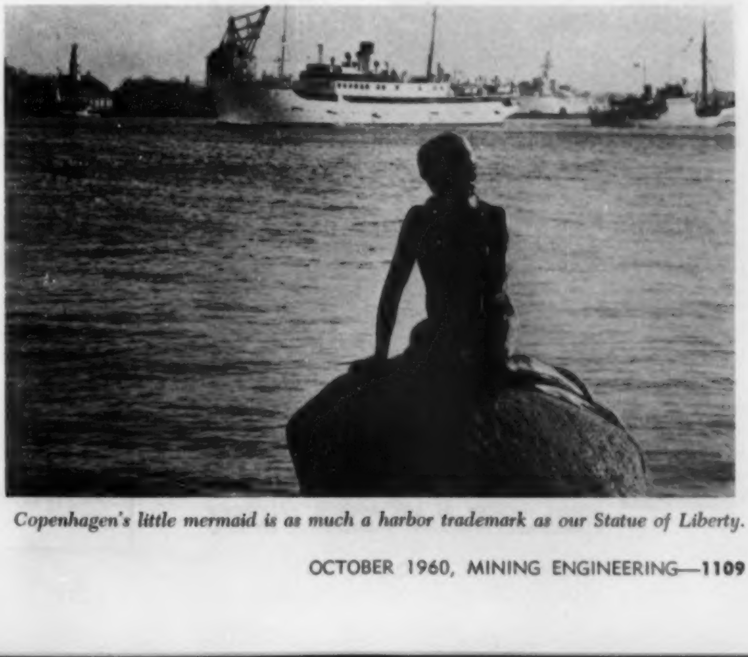
The Scandinavian hosts outdid themselves in hospitality and congeniality. The guidebooks for the field excursions were excellent, and the logistics in each case were well planned and well executed. Even the weather in the North Country was good, and participants of those excursions enjoyed sun bathing at latitude 70°N. During the Congress in Copenhagen one never ventured forth without a raincoat, since at some time during the day he would need it, although most of the day was sunny and mild.

It is too early to say whether great advances in our knowledge of geology and our understanding of geological theory were made. Certainly we had opportunity to see many striking examples of geology, such as the tillite in Varangerfjord in northern Norway and the evidence of the Caledonian overthrust down the backbone of the Scandinavian Peninsula. Some of us saw outstanding mines such as Kiruna and Boliden in Sweden, Outokumpu in Finland, and the Bjornevann iron mine in Norway. There were at least 24 papers on ore deposits given at the technical sessions; of these a paper on the copper-lead-zinc deposits of the Congo by two Belgian geologists and a paper on tin-tungsten mineralization in Czechoslovakia can be cited as serious studies that we Americans would not have had available to us had it not been for a Congress such as this.

Was there anything wrong or anything that would justify complaint about the Congress? Of course there were some mix-ups in rooms and plane reservations, probably bound to occur during an occasion like this, but the only justifiable one seemed to be that good Danish beer cost as much in the Rotunda at the Congress as it does in New York. That annoyed a lot of people! As for the ladies in attendance—between the Danish porcelain and the Swedish and Norwegian glass—they had a wonderful time, and everybody ate too much—but it was good.

Two important decisions were taken by the Council or the delegates: 1) to hold the 1964 meeting in India, from which they had a very cordial invitation, and 2) to organize a continuing international commission that can support the necessary interim work that must go on between congresses.

A most worth-while achievement is in progress—the preparation of a geological map of the world.—*J. L. Gillson.*



Copenhagen's little mermaid is as much a harbor trademark as our Statue of Liberty.

Scholarships

Emmons Memorial Fellowship

The S. F. Emmons Memorial Fellowship in economic geology will be available for the academic year 1961-62. The Fellow may use the stipend ($2000) to support study and research in any university or institute approved by the committee. He should be qualified by training and experience to investigate some problem in economic geology and will be expected to devote full time to the investigation. Its results may, if desired, be used as a doctoral dissertation.

Applications and supporting letters should be submitted to the committee not later than Feb. 15, 1961, and should include a detailed statement of the problem to be investigated. Forms may be obtained from any member of the committee: Alan A. Bateman, Yale University; Charles H. Behre, Jr., Columbia University; and H. E. McKinstry, Harvard University.

Ford Foundation

The Ford Foundation has awarded a grant of $700,000 to the Polytechnic Institute of Brooklyn to establish an honors program in science and engineering which will enable exceptional students to receive a doctorate in six years of full-time study. At present it generally takes from eight to ten years, or more, to receive doctorates.

Thirty-three members of approximately 500 September freshmen have already been selected to take part in the program. In addition to special curricula, the honors students will take part in seminars and special lectures given by visiting and foreign lecturers and will pursue faculty-supervised research projects early in the program.

The grant will allow the college to release faculty members from normal teaching loads, to invite visiting faculty members from other institutions, and to award fellowships and loans for graduate students in the program.

The Anaconda Co.

Four international scholarships for students in mining or engineering have been established at the University of Arizona by The Anaconda Co. The scholarships will be open to two students from Mexico, and one each from Chile and Arizona. They will provide each student with an annual stipend of $1500. In addition, yearly transportation will be provided the student from Chile. These scholarships will be renewable during the four-year undergraduate program upon maintenance of a satisfactory scholastic average. Recipients may enroll in either the College of Mines or the College of Engineering.

In selecting the recipients, the university will be assisted by the recommendations of Anaconda representatives in Chile and Mexico regarding candidates from those countries. The Arizona recipient will be selected by the UA Committee on Scholarship and Awards.

Massachusetts Institute of Technology

The Massachusetts Institute of Technology has announced the establishment of the McDermott scholarships as the result of a gift of more than $1,250,000 from Mr. and Mrs. Eugene McDermott of Dallas. The scholarships will be awarded to students from Texas or other southwestern states, with preference to those studying earth sciences or allied fields. Stipends will range from $200 for students with high qualifications but no financial need to $2500 for those with limited means. About two dozen scholarships were awarded for the year 1960-61, including students from the Southwest who are already enrolled at the Institute. After the first year it is expected that a dozen or more scholarships will be given to incoming freshmen each year, so that there will always be about 50 McDermott scholars enrolled at any one time.

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Vincent D. Perry Recently Named

1961 Jackling Award Winner

Vincent D. Perry, vice president and chief geologist of The Anaconda Co., has been named the 1961 recipient of the Jackling Award.

A native San Franciscan, Mr. Perry spent his childhood in Marin County, among the mountains and woods of northern California, with vacations in mining camps of the California Mother Lode, and in Nevada. These early years of outdoor living, and his passing contacts with the freedom and variety of mining life, stimulated his ambition for a mining career, and he entered the University of California at Berkeley to study under Frank Probert, then Dean of the College of Mining; George Louderback, head of the department of Geology; and many other eminent teachers.

Graduating with a B.S. degree in mining engineering in 1922, Mr. Perry started work as a mining engineer for Carson Hill Gold Mines Inc. at Melones, Calif., remaining there until the fall of 1923, when he went East to attend the graduate school at Columbia University. The combination of operating, engineering, and geological experience gained during this formative period provided a solid foundation for his work at Columbia, where he studied under Kemp, Berkey, and other distinguished members of the faculty, receiving a Master's degree in mining geology in June 1924.

It was then that his long association with The Anaconda Co. began. In that year he went to work at the company's operation in Butte, which proved to be a turning point in both his professional and private life. It was here, in 1926, that he married Margaret Moore, whose help and inspiration were to give him the incentive for a happy and successful career.

At Butte he had the good fortune to participate as an apprentice geologist in the closing episodes of apex litigation then in progress and to learn the art of accurate geologic mapping which, as developed by Reno Sales, created a new language for graphic geologic expression.

Trained in these methods, Mr. Perry was then transferred, in 1928, to Cananea Consolidated Copper Co., Anaconda's subsidiary in Mexico, to serve as chief geologist of that company. The rich Colorado orebody, with its deep subsurface apex, had been discovered previously and was in an early stage of development. His study and mapping of this great orebody by the methods he had learned in Butte provided a start

VINCENT D. PERRY

for systematic mapping and exploration of the Cananea district.

By now he had attained a practical insight into exploration and mining problems that was to set the pattern for his future career, and those who have worked with him have had more than one occasion to appreciate his common-sense approach and his willingness to try out new ideas. He has been the first to give credit to others when these ideas have proved successful, though he himself has often played a more important role than he is ready to admit.

In 1937 Mr. Perry was transferred back to Anaconda Copper Mining Co. as exploration geologist with headquarters in Los Angeles. In 1939 he moved to the company's office in Salt Lake City and in 1944 was appointed chief geologist for International Smelting & Refining Co., an Anaconda subsidiary. The following year he was made assistant chief geologist for Anaconda Copper Mining Co., a post he held until 1948, when he became chief geologist of The Anaconda Co. and after many years in Salt Lake City moved East to the company's headquarters in New York City.

In addition to holding these offices, Mr. Perry is a vice president of The Anaconda Co. (Canada) Ltd. and a director of Greene Cananea Copper Co., Golden Reward Mining Co., Santiago Mining Co., and The Anaconda Co. (Canada) Ltd.

His professional affiliations include membership in Tau Beta Pi, the honorary engineering fraternity, and Sigma Xi, an honorary scientific fraternity, as well as membership in AIME.

During his years of service with Anaconda Mr. Perry has been intimately associated with the development of the Yerington open pit copper mine in western Nevada; the Grants, N. M. uranium operation; the Berkeley pit at Butte; El Salvador copper mine in Chile; the Nakina iron ore deposit of the Lake Superior district, Ontario; and the Bathurst zinc deposit of New Brunswick. He has also been closely concerned with the modern geological developments at Cananea, Mexico and Chuquicamata, Chile.

Vincent Perry's associates have said of him that nothing is too hard for him to do and that he has always found time to complete the job, even if it has meant a long, dark ride during the night, with little rest, or a trek over slippery jungle trails from a broken-down jeep. He has had his share of poor hotels and hard, saggy beds—or none at all—but he is lucky to have a sturdy constitution and an optimistic turn of mind. Others who have worked with him have been fortunate, too, in his good fellowship and his adaptability.

Endowed with a highly developed sense of curiosity, Vin has sometimes had to learn the hard way. Disobeying the "Fasten Seat Belts" sign, he once crossed to the other side of a plane to look out at some rock formations. The plane lurched downward, dropping into an air pocket; Vin went up, cracking his head against the top of the cabin.

But, taking it altogether, he has come through without too many scars, considering a lifetime of travel on four continents and in the areas of the undeveloped, the uncomfortable, and the unknown.

REPORT OF ST. LOUIS—SME COAL DIVISION MEETING

St. Louis Conference Sessions

The technical sessions of the AIME St. Louis Section and SME Coal Division, held on the mornings of September 8 and 9, produced some excellent and varied papers. They were very well received by the 102 attendants as evidenced by the close attention and interest shown by the audiences.

The program opened with an excellent paper given by J. W. McDonald on the shaft sinking of the new Old Ben Coal Corp. mine in Franklin County, Ill. Many of the listeners suggested that this paper be given at AIME's Annual Meeting in February so that more of the industry could hear a prominent engineer give his experience on a subject about which there is a dearth of published material.

The Winning of Fluorspar by Gill Montgomery and Durward C. Spees of Minerva Oil Co. described the mining of this ore in the Rosiclare area. The presentation was illustrated by many colorful slides.

At first glance, the paper *Stripping Machinery Mass-Overburden Volumes Relationships* appeared a bit technical for the strip miners in attendance, but it proved to be an introduction to the application of these relationships, setting up a criterion for securing maximum usefulness from stripping machines in a mining field. This paper was part of a thesis prepared by Henry Rumfelt for his professional mechanical engineering degree.

Some of the Speakers Who Presented Papers


B. L. CURRY


E. L. BILHEIMER

H. RISSER


C. W. KLASSEN

Following the morning technical session and the afternoon field trip, members gathered in the Zodiac Room of the Chase Hotel for a social hour provided by contributions from many mining companies and mine suppliers. Moving up to the Starlight Roof for dinner, the group heard a football talk by Jerry Norton, halfback of the new St. Louis Cardinals football team.

The Friday morning session saw relief from the terrific heat wave. Hubert E. Ritter, of the Illinois Geological Survey, offered an interesting paper on the coking of Illinois coals. Many predictions about the use of Illinois coals can be made from information presented at this meeting.

A paper on Oklahoma-Arkansas coals by B. L. Curry of Lone Star Steel Co. summarized the geology, analysis, and reserves of thin seams to this area and covered the mining history. This was an introduction to the coal mining possibilities of a region that is new to most of us.

St. Louis is soon to become the outlet for a large new iron mine. E. L. Bilheimer, of the Meramec Mining Co. Pea Ridge project, displayed aspects of the new mine with 36 colored slides as he described the reserves and explained the shaft sinking and construction.

The sessions ended with a talk by Clarence W. Klassen, Chief Sanitary Engineer of the Illinois Department of Public Health and a member of ORSANCO. Stream pollution was the subject of Mr. Klassen's talk, which raised many questions from the audience and subsequent discus-

Pictured at speaker's table, left to right: Philip Dampf; Joseph Quinn; Gill Montgomery; J. W. McDonald; Durward Spees; Eugene Mauck; Jerry Norton, guest speaker and St. Louis Cardinals halfback; Norl Hamilton; Henry Rumfelt; Hubert Risser; and B. L. Curry.

A relaxed interlude during a morning technical session at the St. Louis AIME and Coal Division SME meeting in the Chase Hotel.

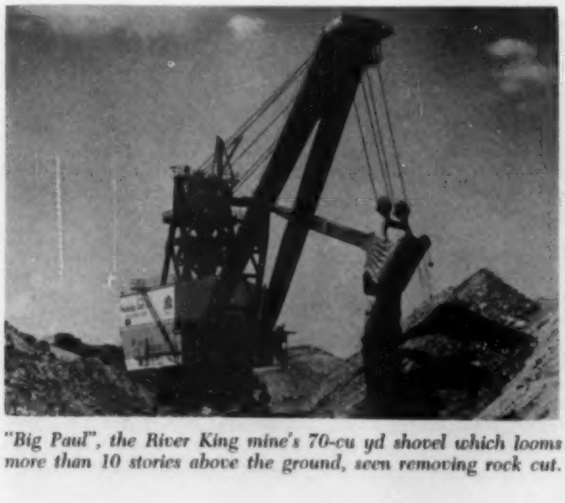
sions by Mr. Klassen. The problems of maintaining pure water supplies in our streams is one which vitally concerns mining companies everywhere.

Field Trip

It was hot in St. Louis during the Joint Conference of the AIME St. Louis Section and SME Coal Division, but those who attended took the weather in true miner's stride when they visited the River King mine on September 8—although the thermometer registered 99°F. After the morning technical session, buses left the Chase Hotel for a 25-mile ride to Augustine's Restaurant in Belleville, Ill., for a luncheon stop.

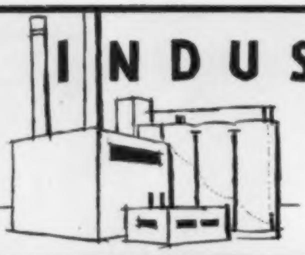
Another 6-mile ride, and the buses arrived at the site where the excavators, coal loader, trucks, and drills were grouped in the center of the mile-long pit. Every machine was working in excellent view of the visitors. "Big Paul," River King's 70-cu yd shovel, was busy removing the rock cut immediately below the visitors in what appeared to be a stage setting. It was followed closely by the Bucyrus wheel excavator, which removed the top one-third of the 75-ft overburden. Two 50R overburden drills, working on the wheel bench cut, were pluming white limestone dust exhaust in boring for the overburden blasting. The Bucyrus 170B coal loader was dripping coal from its bucket at each swing in loading the 12 coal-haulage trucks to keep ahead of these two giant earth movers. According to the guides, who explained the operations to the visitors, the shovel will average 2 million cu yd per month and the wheel, which has been in operation less than a month, is expected to exceed 1 million cu yd per month. River King mine will produce more than a quarter of a million tons of coal each month during this coming winter.

When it was time to leave River King mine for the East St. Louis coal-loading dock on the Mississippi River, it was discovered that one of the buses had become vapor-locked from standing in the heat. Five men pushed the bus by hand while 30 men inside urged them to hurry and catch up with the other buses. The river dock was loading the last barge for the day when the visitors arrived. They filed up the conveyor gallery and the walkways of the barge mooring cells. Cars are dumped here by a three-man crew at 1200 tph, and the trainloads of 30 railroad cars of coal from the mine are handled by the novel car hauls. These consist of an endless wire rope of 2-in. cables, running on the ties in the center of each of two tracks and fastened to a barney car on each track, which serves to connect each train of 30 cars. This rope is pulled by a drum at the side of the tracks and controlled by the car dumper man. Several of the visitors commented on how easily and efficiently the work was accomplished at the dock and the mine.—*W. A. Weimer.*



"Big Paul", the River King mine's 70-cu yd shovel which looms more than 10 stories above the ground, seen removing rock cut.

Bucyrus wheel excavator at the River King mine shown in the process of removing the top one-third of the 75-ft overburden.



INDUSTRIAL MINERALS NEWSLETTER

PROGRAM PLANNING OCCUPIES DIVISION OFFICERS

Annual Meeting

Dear Members of IndMD:

Program Chairman Dick Lund reports that as of the date of writing (mid-August) the Annual Meeting program is shaping up well in four of the six sessions. For the session on raw materials for the chemical industries in the Midwest four papers are scheduled to be presented by Thomas Beveridge, Dale W. Kaufman, K. K. Landes, and W. F. O'Brien. Topics will be *Industrial Minerals for the Chemical Industry; Rock Salt Mining and Economics; Limestone;* and *Lithium Raw Materials,* respectively.

The transportation session consists of five papers: one on transportation economics by W. A. Riggs; two on transportation in the Canadian north country—one by Amil Dubney and the other by Nick Gritzuk; a paper on water transport by Odin Wilhelmy; and a study of the economics of a 5½-mile belt conveyor by Tom Douglas.

The industrial waters program includes a paper on water use in the mineral industry by R. T. MacMillan and a reappraisal by Nathanial Wollman of the *Paley Report Projections of Water Production and Use.* V. C. Williams will discuss the economics of saline water conversion and O. L. Mussey will describe the use of water in iron mining and milling.

An interesting session is in prospect under the title CONFLICTING INTERESTS IN EXPLOITATION OF INDUSTRIAL MINERALS. Orris Herfindahl will present a broad introduction. The conflict of mining and quarrying vs urbanization; highway use; and water storage will be covered by Hall Goldman, Ralph Bernhagen, and Thomas Maddock, Jr., respectively. Hollis Dole will discuss the conflict of mining and withdrawals of public lands.

No information is available for the sessions on mineral aggregates and fillers or fibers and pigments.

Southwest Minerals Conference

Plans for the Southwest Mineral Industry Conference at Las Vegas in April 1961 are progressing favorably. J. K. Brooke, IndMD's Southwest Vice Chairman, is representing our Division and reports there are 11 possible industrial minerals papers available. An interesting program covering a wide range of subjects is in prospect.

Industrial Water

Raphael G. Kazmann, chairman of the IndMD Industrial Waters Committee, has directed the following appeal for more interest and activity in water—our most important commodity:

"Water is a peculiar sort of commodity—it is not only an industrial mineral but also an industrial nuisance. In addition there are at least half a dozen other engineering and scientific organizations interested in water, so why should the mining engineers sponsor it as a commodity on a par with asbestos, limestone, or copper? Here's why:

"All of us are in the business of producing basic minerals for the market. The minerals must be found, produced, beneficiated if necessary, transported to the market, and sold at a competitive price. This describes the position we're in with respect to water—inadequately. Not only is water used in the production of other minerals, but it is also usually necessary to get rid of ground water in mines, and the same techniques used to produce water, the commodity, can be used to get rid of water, the nuisance. Moreover, there is a whole body of law governing water, the commodity, that can hamper or restrict dealing with water, the nuisance—and thus interfere with the production of other minerals and ores.

"The Industrial Waters Committee is, naturally, interested in all phases of ground water exploration, evaluation, and development—this includes producing water for use, or producing water to keep it from hampering the operation of mines. Papers on such diverse but associated problems as pumping equipment, water laws, or land subsidence will also be welcomed.

"Then there is the beneficiation problem: conversion of saline waters to potable water by chemical or electrical processes or other methods. Many optimistic statements on water cost fill various mass circulation periodicals—and although they sound like fact, they are usually wishful thinking. One of our tasks might be to separate fact from fancy.

"Another topic might be techniques for the evaluation of small surface reservoir sites on sediment-carrying streams: as the sediment accumulates the firm supply available will decrease and the cost of water will rise. This is roughly analogous to the mining-out of an orebody or the depletion of an oil deposit.

"Finally, there is a field of policy which is broader even than water law—the hammering out of a mutually agreeable way to resolve or arbitrate conflicts in resources development which involve water. Examples of this might be the flooding of mineral deposits by reservoir construction or the draining of lakes and swamps (potential destruction of wildlife) to gain access to an orebody. As the population increases such problems will become increasingly important, and now is the time to work out a procedure to resolve them."

If any of this rings a bell, step up and join the committee! The Industrial Waters Committee wants to hear from you and to receive your suggestions as to what should be done and how the Committee can organize itself most effectively. If you have ideas for a paper, there is still an unfilled slot in the 1961 program—and there are other meetings coming up.—*John S. Holland*

Around the Sections

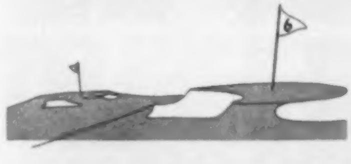
• The **Philippine Section** held its quarterly meeting July 28 at the Casino Espanol de Manila. Seventy-three members and guests enjoyed the stag dinner. Afterwards Charles A. Mitke was presented the Legion of Merit award and told of his many interesting experiences in the profession over the past 50 years.

Benjamin M. Gozon, director of the Philippine Bureau of Mines, was guest speaker. He reviewed the progress of the Philippine mineral industry for the past year and noted the encouraging signs for the years to come. Discussion of the speech and a question-and-answer period followed.

To round out the program, Donald A. Smith, secretary-treasurer of the Section, gave a brief talk on AIME, pointing out the advantages of membership and inviting the qualified nonmembers present to join the Institute.

• **Bisbee-Douglas Subsection** (Arizona Section) held its monthly meeting August 10 at the Top Hat in Douglas, Ariz. Seventy people saw *The Boyles Brother Story*, a film presentation shown by Joseph Roberts, field superintendent of Boyles Brothers Drilling Co.

• Tupper Lake Country Club at Tupper Lake, N. Y., was the site of the **Adirondack Section** meeting held Saturday, August 27, where golfers



enjoyed themselves on the fine 18-hole course. In the afternoon, beginning at 4:30, a symposium was held on automation and modernization. Section members from several plants within the Section area participated. Guest speakers were Jim Shepard of Minneapolis-Honeywell and Frank Briber of Allis-Chalmers. Dinner was served at 6:30 p.m. Section members were invited to the dance scheduled at the Country Club later that evening.

• The Copper Country was host to the **Upper Peninsula Section** members, wives, and guests at the fall annual meeting September 10. Conducted tours through the Lake Linden operations of the Calumet Div. of Calumet & Hecla Inc., Ahmeek Steam Hoist, and Keweenaw County were highlights of the day's program. Coffee and doughnuts were served during the registration period, held on the campus of Michigan College of Mining and Technology from 9 to 10 a.m.

At the conclusion of the morning tour, the party gathered at the Elk's Club in Calumet for a buffet luncheon. After lunch the Section met for a short business session, as did the Woman's Auxiliary.

The afternoon tour of Keweenaw County ended at the Main Lodge, Keweenaw Park, with a cocktail hour followed by dinner. Jean Worth, editor of The Escanaba Press, was guest speaker.

• The **Utah Section** and **Utah Coal Section** held a joint meeting June 16 at Sunnyside, Utah. During the afternoon members and their guests had a choice of three field trips, a game of golf, or a swim at the indoor pool in East Carbon High School. The field trips included a visit to a high coal—high production section in the No. 1 mine of Kaiser Steel Corp. featuring a continuous miner; a visit to both a conventional section using yieldable arches as roof support and a continuous miner section using roof bolts and timber as roof support in the No. 3 mine of Kaiser Steel Corp.; and a tour of the outside facilities, which included the preparation and backfill plants and the new fan installation over a 770-ft shaft into the No. 1 mine.

A barbecue and social held in the evening at Sunnyside Park brought the day to a close in an atmosphere of informal camaraderie and good humor. Seventy people in all attended the meeting.

Utah Coal Section refreshment committee members who served as bartenders and chefs. Left to right: Nick Halamandaris; Gus Piantes; Joe Taylor, Section Chairman; Tom McCourt; Frank Markosek; John Meredith; Bruno Dallo Corte; Vincent Hyatt.

Shown enjoying the barbecue which highlighted the joint Utah Section—Utah Coal meeting at Sunnyside in June are John Peperakis (left), manager of the Sunnyside Coal Mines, and Glen Burt, past chairman of the Utah Section.

Personals

W. J. FENTON

C. N. GILMORE

A. S. HORCASITAS

T. E. BAN

Stein, Hall & Co. Inc., New York, announced that **William J. Fenton** has joined their Canadian subsidiary, Stein Hall Ltd., Toronto, as a sales and technical representative to the Canadian mining industry. He will represent Stein Hall Ltd. throughout Canada and will also visit some areas in the U.S. Mr. Fenton has had 23 years experience in the Canadian mining industry, including ore dressing operations on gold, silver, and uranium, as well as metallic and nonmetallic mineral separation.

Charles N. Gilmore has been appointed mine industrial engineer for the New York ore division of Jones & Laughlin Steel Corp. Mr. Gilmore succeeds **F. D. Woodworth,** who has resigned. Gilmore joined Jones & Laughlin in 1953, shortly after his graduation from Duke University.

David Williams, professor of mining geology and head of the department of geology, Royal School of Mines, Imperial College of Science and Technology, was inducted into office as president of the Institution of Mining and Metallurgy at the annual general meeting held at Burlington House, London. During the meeting the Institution gold medals for 1959 were awarded to **Edward Duffield McDermott,** in recognition of his distinguished services to the mining industry and profession and his services to the Institution as its representative on the governing body of the Imperial College of Science and Technology; and to **Julius Kruttschnitt,** in recognition of his distinguished services to the mining industry in Australia. Mr. Kruttschnitt, who is a native of the U.S., went to Australia in 1931 as general manager of Mount Isa Mines Ltd. and shortly afterwards became chairman of directors. It is largely to his leadership that the success of the Mount Isa operations can be attributed.

Raymond Garcia-Loera has taken a position as field engineer for Acero Fagersta, Mexican subsidiary of Fagersta Bruks Aktiebolag of Sweden.

A. S. Horcasitas, who was chief geologist for El Potosi Mining Co., with which he was associated for 32 years, has opened a consulting office in Chihuahua, Mexico, doing mine examination and reports on standing of companies in Mexico.

McDowell Co. Inc. recently announced the election of **Thomas E. Ban** as vice president-research. Mr. Ban, who joined McDowell in 1955 as director of research, is responsible for operation of the company's Dwight-Lloyd Research Laboratories of applied minerals processes research.

E. P. Pfleider, chief of the division of mineral engineering, has succeeded **S. R. B. Cooke,** chief of the division of metallurgical engineering, as head of the School of Mines and Metallurgy in the Institute of Technology, University of Minnesota. This change, which became effective on June 15, follows the organizational arrangement of rotating division chiefs to head the department.

Stanley M. Moos has been awarded the professional degree of metallurgical engineer by his alma mater, the University of Arizona, for achievements since graduation. He received his B.S. in mining engineering in 1938 and since graduation has been active in Mexico and Central America, particularly in the construction of ore dressing plants. He is presently a consulting engineer with offices in Mexico and Houston.

F. L. McDonald has been transferred from Niagara Falls, Ont., where he was plant manager for Cyanamid of Canada, to Baie Durpee, Que., where he will fill the position of general sales manager of the industrial products department of the firm.

David Kerr-Cross has completed his UN assignment in India and plans to return to Canada in the fall via London and New York.

Louis W. Cope, formerly general superintendent for Cia. Minera Los Angeles, S.A. in Honduras, has moved to Peru to become superintendent of mills for Compania de Minas del Peru's plants in Puno, Cusco, and Arequipa.

Arthur G. Matherly has gone to Lima, Peru, on a two-year contract with Marcona Mining Co.

Crucible Steel Co. of America recently announced the appointment of **Charles B. Tillson, Jr.,** as manager—raw materials (coal). He will be responsible for planning, analysis, coordination, and establishing policy of the company's coal activities. Mr. Tillson, formerly assistant manager—fuel division, joined Crucible in 1952. Before coming to Crucible Mr. Tillson spent 15 years with Bethlehem Mines Corp.

Francis Young, who is with Ste. Nord Africaine Duplo in Morocco, was seriously injured in an auto accident late last year and has just recently recovered sufficiently to be out of bed.

Parry Barnes, who was formerly sales training manager for the Construction Machinery Div. of Clark Equipment Co., is now sales development manager of the division.

C. B. Berglund, who has been with Atlas Copco in Sweden, is going to Johannesburg, South Africa, as a chief consulting engineer and technical adviser for the company in Africa.

The Bituminous Coal Research Inc. presented its annual award for outstanding leadership to **H. J. Rose,** retiring vice president and consultant of the organization, an affiliate of National Coal Assn. Mr. Rose, who came to Bituminous Coal Research in 1945, has been employed in coal research since 1918.

Dennis L. McElroy, executive vice president of Consolidation Coal Co., has been chosen by the staff of the Encyclopedia to prepare an article on coal mining for the forthcoming *McGraw-Hill Encyclopedia of Science and Technology*. The article is based largely on Mr. McElroy's experience over the past 33 years in the mining industry.

After five and a half years with the U.S. Atomic Energy Commission in Bakersfield, Calif., as geological engineer, **Arthur J. Richards** has joined Honolulu Oil Co. as a geologist.

Stoddard S. Burg recently returned to U. S. Steel, Coal Div., after a year's leave of absence during which he participated in the Sloan Program for Executive Development at Massachusetts Institute of Technology. This program includes academic work leading to a Master's degree and travel in the U.S. and Europe for the purpose of meeting with government and industry leaders.

Daniel A. Jones, who had been project supervisor of the Records Im-

provement Project for the Fairbanks Land District, with headquarters in Washington, D. C., has been transferred to Fairbanks, Alaska, as land office manager for the Fairbanks Land Office. In this post he will be responsible for all land and mineral activity on public domain land in the Fairbanks area. Shortly after his arrival in Alaska, Mr. Jones presented a paper entitled *Alaska's New Public Land Records* at the fifth annual Mining, Minerals, and Petroleum Conference at the University of Alaska.

Antonio Madero is spending the summer working for Cia. Mexicana de Credito Industrial S. A. in Mexico City, during his vacation from Harvard Business School.

Weng Sek Tham, who had been doing post-graduate research in coal mining at the University of Otago, New Zealand, has returned to his native Malaya to take a job as mining engineer with Pahang Consolidated Co. Ltd.

The University of Alaska recently announced the retirement of **Ernest N. Patty** as president, after seven years of service. He was dean of the College and head of the School of Mines at the University of Alaska from 1922 to 1935. From 1935 to 1953 he was president and general manager of extensive gold-dredging operations in Alaska and Yukon Territory. In 1953 the Board of Regents called him back to the University and during his regime the campus has been almost completely rebuilt and enrollment has tripled.

Mr. Patty remains active as president of Alluvial Golds Inc. and Gold Placers Inc., two Alaska gold dredging companies, and will undertake a limited amount of consulting work.

L. R. Brown, Jr., has been promoted from assistant superintendent of the Morococha Div. to superintendent of the San Cristobal Div. of Cerro de Pasco Corp.

Doring C. Dahl has taken a position as project engineer for Soil Testing Services. He had formerly been with Stone & Webster Engineering Co. as a field engineer.

David H. Curry, Jr., project superintendent for Centennial Development Co., has been transferred from Gallup, N. M., to Globe, Ariz., to work on the vent shaft for Inspiration Copper Co. at the company's Christmas development.

Edward M. Yates moved to Trail, B. C., to begin his career in the mining industry with a job with Consolidated Mining & Smelting Co. of Canada.

R. Antony Lee, who has served as mine manager for the past six and a half years with Tweefontein United Collieries Ltd., Transvaal, South Africa, has been promoted to resident mining engineer, a new post created following expansion of the group's coal mining activities and involving responsibility for operations at the coal mines of the company and its associated companies.

Oscar W. Bilharz was recently appointed director of the Office of Minerals Mobilization, according to an announcement from the Department of the Interior. Mr. Bilharz has served as acting director since the retirement of **Spencer S. Shannon** the end of last year. He began his mining career in 1921 in the Tri-State zinc and lead mining district. In 1923 he became president of O. M. Bilharz Co. Inc. and as an independent operator continued to interest himself in the exploration, development, and operation of various mining enterprises in the Tri-State district. In 1953 he disposed of all of his holdings and retired from active mining. He remained in retirement until June 1956, when he was called to Washington as a consultant in the Office of Minerals Mobilization. In September 1956 he was appointed coordinator for base metals, the position he held at the time he was named acting director of the Office.

The Bunker Hill Co. recently announced the appointment of **Joseph T. Hall** as a director, filling the va-

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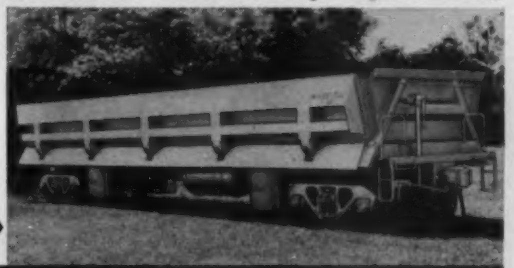

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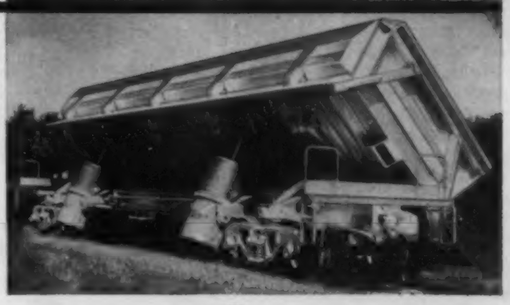

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cancy left by the death of **John D. Bradley** last November. Mr. Hall is president of Callahan Mining Corp., which owns the silver-copper producing Galena mine near Kellogg, Idaho, site of Bunker Hill's major operations. The corporation recently increased its holdings in Bunker Hill stock by purchasing 100,000 shares from the Hecla Mining Co. Hall went to work for Callahan Mining Corp. in 1936 and was elected president in 1945.

Jay C. Shoemaker, formerly manager of Mico Mining & Milling Co., Marion, Ky., has moved to Denver, where he has taken a position as field engineer with Denver Equipment Co.

Walter B. Lenhart, who has been with *Rock Products* for almost 35 years as West Coast editor, retired June 1st.

Charles L. Knaus has been appointed project engineer for McCreary-Koretsky, on the construction of Sunset City, a 12,000-acre tract near Rocklin, Calif.

Earl C. Herkenhoff, formerly chief metallurgist with Utah Construction Co. in Palo Alto, Calif., has moved to San Francisco to assume the position of vice president with Marcona Mining Co.

The University of Idaho honored **Arthur W. Fahrenwald,** *Mr. Mining*, during commencement exercises held June 5. In presenting him with a certificate of merit, President D. R. Theophilus said, "By improving metal recovery and lowering the cost of processing, Dean Fahrenwald's metallurgical machines have have made available for the use of mankind millions of tons of valuable metals that otherwise would remain imbedded in the earth." Mr. Fahrenwald had served as dean of the college of mines and director of the Idaho Bureau of Mines and Geology for 21 years until his retirement in 1954. He had been a member of the faculty for 41 years.

At its 43rd annual meeting, the National Coal Assn. elected the following officers: **Herbert E. Jones, Sr.,** co-founder of Amherst Coal Co., chairman of the board of directors; **George E. Enos,** president of Enos Coal Mining Co., vice-chairman; and **David L. Francis,** president of Princess Coals Inc., treasurer. **Stephen F. Dunn** continues as full-time president of the Association. On the eve of the annual meeting, the board of

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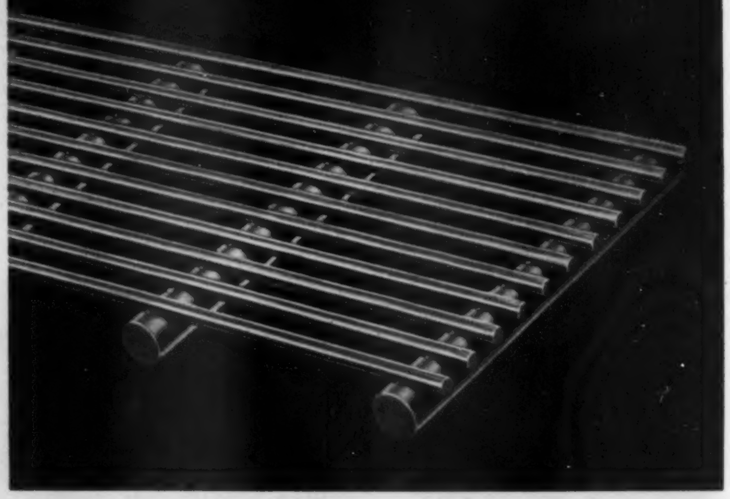

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directors elected **G. A. Shoemaker,** president of Consolidation Coal Co., to fill the vacancy on the board left by the death of **Armstrong R. Matthews** early in April.

The Lake Superior Mines Safety Council elected officers for the year 1960-1961 at its business session held recently. They are: **L. J. Hall,** president; **Walter O. Gunelson,** vice president; **Allen D. Look,** secretary; and **A. J. Windl,** treasurer.

National Coal Assn. recently announced the appointment of **Samuel F. Stepp** as staff engineer in its Bituminous Coal Institute Dept. He will be assigned to the Washington, D.C. office. Prior to his appointment, Mr. Stepp was assistant director of public property for the State of Minnesota.

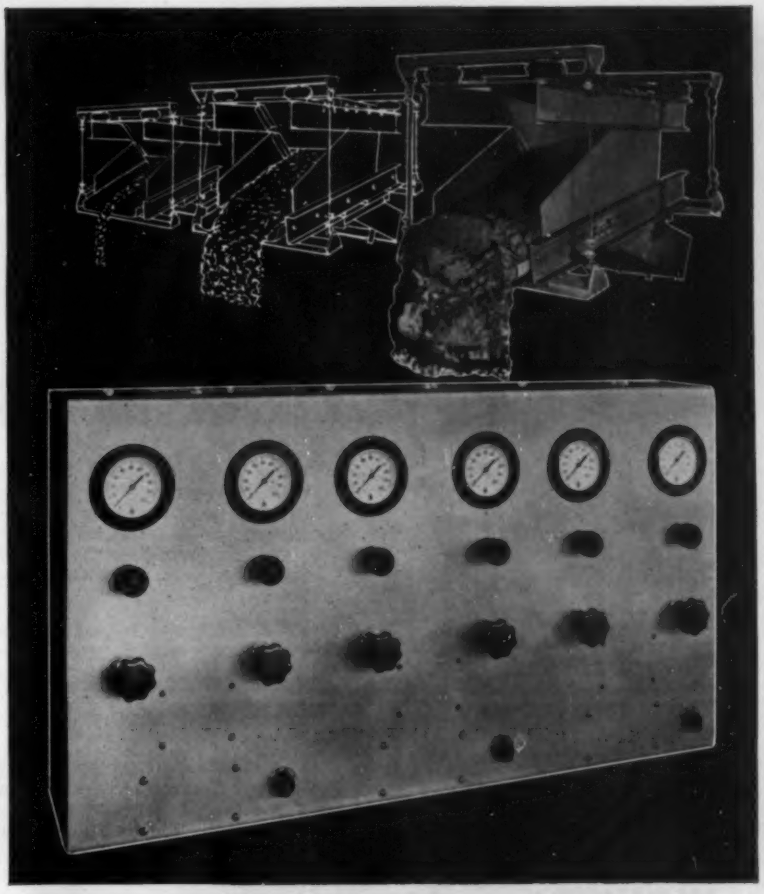
Paul Eimon has been appointed chief geologist for Neptune Gold Mining Co., Bonanza, Nicaragua, a subsidiary of American Smelting & Refining Co. For the past year, as assistant exploration supervisor, Eastern U.S. Div., American Smelting & Refining Co., Mr. Eimon has been working out of Ironton, Mo., in connection with southeastern Missouri exploration.

The Cleveland Cliffs Iron Co. recently announced the election of **H. S. Harrison** as president. Mr. Harrison, formerly executive vice president, succeeds **W. A. Sterling,** who will continue as chairman and chief executive officer.

Four SME members were awarded professional degrees by the Montana School of Mines during recent commencement exercises there. The degree of mineral dressing engineer was awarded to **Edward P. Cadwell,** chief metallurgist, American Cyanamid Co. and to **Walter E. Duncan,** Natural Resources Research Institute, University of Wyoming. **William H. Love,** general manager, Hecla Mining Co., and **Neil A. O'Donnell,** senior partner in the firm of O'Donnell and Schmidt, were awarded the degree of engineer of mines.

Frank B. Wolcott left Sawhill Tubular Products Inc., where he was executive vice president and director, to go into the management consulting field in his own company. He and his wife are presently on a six to eight-months vacation cruising the Caribbean Islands on their sloop.

David D. Eyer, a mining engineering senior at Lehigh University, was this year's recipient of the Old Timers Club award. The club is composed of men prominent in the coal industry and is dedicated to the promotion of worthy activities towards the betterment of coal mining.



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continued

M. GRATACAP

E. L. OHLE

Maurice Gratacap, a UN technical assistance expert, recently returned from Argentina, where he has been consultant to the Minister of Mines and Oil and professor on mining economics at the Regional Geological Institute.

Ernest L. Ohle was recently named vice president, exploration, Copper Range Co. He has been chief geologist of the company, and its subsidiary, the White Pine Copper Co., since 1957.

Richard J. Menze has left Magnet Cove Barium Corp., where he was plant manager, to take a position as assistant production manager of the Consolidated Feldspar Dept. of International Minerals & Chemical Corp.

D. M. Maclean, who was mine manager for Campbell Chibougamau Mines Ltd. at Chibougamau, Que., has moved to Toronto, where he is working as chief engineer for the company.

Theodore S. Jordan has taken a job as project engineer with Vanadium Corp. of America. He had been a member of the faculty of the Montana School of Mines for two years.

R. Waissar, who has been doing graduate work at the Colorado School of Mines for the past two years, has gone to Venezuela as a mining engineering trainee with Orinoco Mining Co.

William Devitt has taken a position as assistant to the superintendent, Missouri operations, with Milwhite Mud Sales Co. He is presently general foreman at the Palmer, Mo. residual barite mine and washing plant to become familiar with local operations. Prior to joining Milwhite, he was tram and quarry maintenance foreman for U.S. Gypsum Co.

Frank M. Randall, who has been general mill foreman for Cerro de Pasco Corp. in Peru, has joined Campania Minerals Santander Inc., Lima, Peru, as mill superintendent.

Charles J. Potter was recently elected to his 13th consecutive term as president of Rochester & Pittsburgh Coal Co.

Following his two-year tour of duty with the U.S. Army, **Richard E. Dawes** has taken a job as quarry engineer with U.S. Gypsum at the company's Sweetwater plant.

M. L. Nielsen has spent the summer in Alaska with an exploration unit for Sinclair Oil and Gas. Upon his return, the company is transferring him to Tulsa.

Irving G. Irving has taken a job with the Atomic Energy Commission as geological engineer in the production—evaluation department of the Plateau branch. He was formerly co-manager of the Norwich mine, Butte, and an independent consultant.

Kerr-McGee Oil Industries Inc. recently announced some organizational changes in its minerals division. **V. L. Mattson**, formerly manager of mining and milling, has been named general manager, minerals; **R. T. Zitting**, formerly manager of mineral exploration, has been named manager, mineral exploration and land; and **Phil Ellsworth**, formerly district geologist at Golden, Colo., has been promoted to chief geologist, (minerals.)

Walter R. Guggenheimer, previously mine foreman for Cerro de Pasco Corp. in Morococha, Peru, has been transferred to Yauricocha, Peru, where he is serving as general mine foreman.

Donald F. Redfearn has left Olga Coal Co., where he was employed as a mining engineer, to take a similar position with Freeman Coal Corp. in Herrin, Ill.

Theodor H. Köhler has become affiliated with Empresa Minera de Mantos Blancos in Antofagasta, Chile. He was formerly associated with Cia. Minera Condoroma in Arequipa, Peru.

Donald Towse has been transferred from Kaiser Aluminum & Chemical Corp. to Kaiser Permanente Cement Co., where he will be project geologist in charge of geologic studies of raw material deposits, with responsibilities in exploration, mine planning, and evaluation.

Ross V. Seeton, Jr., former vice president and manager of the mining division of Shelton-Warren Oil Co., has become president of Rainbow Placer Inc. The company is in the process of subdividing its placer claims along 414 miles of trout stream in Taylor Park, Colo., into cabin sites. Some construction of cabins is also anticipated.

Wilfred Alexander Lyons has moved to Pisco, Peru, to take a job as geologist with Castrovirreyna Metal

Mines Co. He had been a geologist with Corporacion Minera de Bolivia, Oruro, Bolivia, for the past three years.

R. Robbins Spencer has become manager for Langer Equipment Co. in Hibbing, Minn., after 14 years with Calumet & Hecla Inc. as project engineer and mechanical superintendent.

Alfred D. Wandke, a consulting geologist, who has made his headquarters in Cuba for the last eight years, has moved his consulting practice to Pompano Beach, Fla.

Cerro de Pasco Corp. has promoted **R. W. Phendler** from geologist to senior geologist and transferred him from Lima, Peru, to La Oroya, Peru.

J. M. Macintyre has left Climax Molybdenum Co., where he worked as a mechanical engineer, to become plant engineer for Southwest Potash Corp. in Carlsbad, N. M.

Lucio A. Quiñones has taken a job as level boss with Kermac Nuclear Fuels Corp. in Grants, N. M., after working as mine foreman for three years with Cerro de Pasco Corp. in Yauricocha, Peru.

Henry J. Petrie has been named sales manager of the New York office of the Traylor Engineering and Mfg. Div. of Fuller Co. He was formerly director of industrial sales for Vitro Engineering Co.

Upon graduation from Michigan College of Mining and Technology, **Gary M. Dorland** has gone to work as a metallurgical engineer in the ores research department of Iron Ore Co. of Canada.

W. L. Kendrick, formerly vice president and general manager of Manganese Inc., a division of Howe Sound, has become vice president and general manager of Tungsten Mining Corp., another division of the company. The corporation has rehabilitated the Hamme mine and mill, on the outskirts of Henderson, N. C., and is bringing it up to full production.

Bert L. Renzetti, formerly senior geologist for Kaiser Aluminum & Chemical Corp., has become resident geologist in Chile for Cerro de Pasco Corp.

William J. Coulter, vice president and general manager of western operations for Climax Molybdenum Co. at the time of his retirement in 1953 after 27 years with the company, has moved from Denver, where he maintained a consulting office, to Lake Tahoe, Nev. He and Mrs. Coulter plan to make their permanent home there now that he has retired completely from business activities.

Lynn Harmsen has moved to North Creek, N. Y., to take a job as engi-

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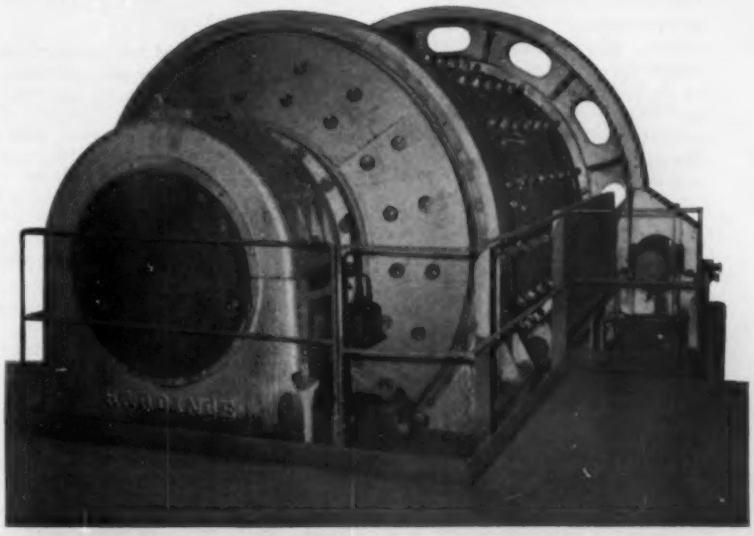

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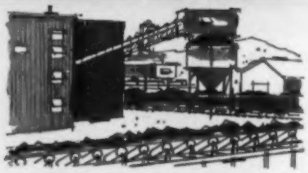

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neer with Barton Mines Corp. He had been working as a mine engineer for U.S. Gypsum Co. in Virginia.

A. B. CUMMINS

L. R. BLAIR

After 36 years with Johns-Manville Research Center in Manville, N. J., SME President **A. B. Cummins** retired July 1. He had held the position of manager since 1956. **L. R. Blair,** who has been named to succeed him, began his association with the Research Center in 1954. Until now he has been chief of the Basic Chemistry Research Section.

R. N. Breckenridge, formerly general superintendent for Eureka Corp. Ltd., Eureka, Nev., has taken up residence in Salt Lake City.

Adrian C. Dorenfeld has accepted an appointment as associate professor of mineral engineering at the University of Minnesota School of Mines. He had been general manager of Roberts & Associates, Los Angeles, and recently completed a consulting assignment for Israel Mining Industries at the 2000-tpd copper leaching plant near Elath, Israel. He also visited Cyprus and Turkey.

Luis A. Jauregui has left Cia. Minera de Cerro Negro, where he was employed as a superintendent, to take a similar position with Productora de Bario S.A.

John S. McNabb, Jr., former vice president for mining with Twin Star Industries Inc., has joined the TKL Oil Corp. as a mining engineer.

John L. Sharper has moved from Ironwood, Mich., where he worked as assistant superintendent for the Mauthe Mining Co., to Youngstown, where he has taken a position as operating assistant, raw materials, with Youngstown Sheet & Tube Co.

After 12 years with Braden Copper Co., where he was general mine foreman, **Guido Bosio** has moved from Raucagua, Chile, to Santiago, Chile, where he acting as an independent operator.

Joseph E. Worthington is now affiliated with the Bear Creek Mining Co. in Tucson, Ariz. He was previously a geologic consultant for American Telephone & Telegraph Co. in Pennsylvania and Maryland.

Upon graduation from EOD and Special Weapons Disposal Schools, **Earl R. Hoskins** has been posted to an explosives ordnance disposal unit in Hawaii by the U. S. Navy.

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W. MACGREGOR

Nordberg Mfg. Co. recently established an office in Dallas and appointed **Eugene T. Daum** sales engineer there. He was formerly a sales engineer in the St. Louis office.

Wallace Macgregor, an executive with Climax from 1950 to 1957, has been elected president of the Climax Molybdenum Co., according to a recent announcement by the parent firm, American Metal Climax Inc. He will also assume duties as vice president of the parent firm. Mr. Macgregor replaces **Frank Coolbaugh,** who left the Climax presidency this spring to become president of the parent firm. From January 1958 until assuming his new position, Macgregor was a vice president of Homestake Mining Co.

Desh B. Sikka, this year's recipient of the President's Gold Medal and first prize awarded by the Canadian Institute of Mining and Metallurgy, recently obtained his Ph.D. from McGill University. As geochemical supervisor for Sulmac Exploration Services Ltd., he has been prospecting for iron in Labrador. He expects to return to India in the fall.

Robert Hall has left Foote Mineral Co. to take a job as mine engineer with Tungsten Mining Co.

John H. Ratcliffe has severed his connection with Lundberg Explorations Ltd. to take a position with Phelps Dodge Corp. of Canada Ltd.

H. R. Deeth, formerly a vice president with American Nepheline Ltd., Toronto, has become vice president of marketing for American Nepheline Corp. in Columbus, Ohio.

After a year's leave of absence while he attended Massachusetts Institute of Technology as a Sloan Fellow, **R. W. Ballmer** has resumed his position as production superintendent at the Ray Mines Div. of Kennecott Copper Corp.

Ira E. McKeever has been appointed general manager of sulfur operations of Texas Gulf Sulphur Co. He will have direct charge of sulfur operations throughout the Gulf Coast region and will maintain headquarters in Newgulf, Texas. From 1956 to 1959, as vice president of Texas Latin Exploration Co. (a Texas Gulf subsidiary), he had charge of a drilling program in Sicily and supervised geological inspections in Egypt, Ethiopia, and Germany. Since his return from Sicily last year he has undertaken assignments for the company in the U.S. and Australia.

Philip C. Moore has left Allied Chemical Corp., where he was in technical sales for the nitrogen division, to take a position as explosives engineer and manager of the chemical division of The Ringgold Corp.

L. W. Emerson, who has been retired since 1938, except for consulting work during World War II, has moved from Yarmouth Port, Mass., to Mansfield, Ohio.

E. A. Eastman has been promoted from plant metallurgist at Jones & Laughlin Steel Corp.'s Star Lake, N. Y. plant to chief metallurgist of the company's Minnesota Ore Div.

Michigan Chemical Corp. recently announced that **Judson H. Whitman** has been advanced to the position of assistant director of the company's Rare Earths and Thorium Div. He joined the company in 1957 as a mining engineer in the same division. He will be in charge of special projects and assignments related to the company's rare earths program. He will also continue to handle the division's raw materials and mining and exploration activities.

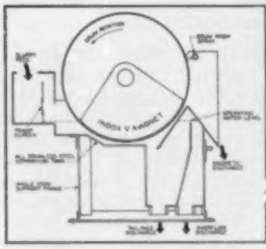
Charles W. Kelley, Jr., formerly a grinding and leach foreman for Anaconda Co. at its operation in Grants, N. M., has moved East to take a job as block plant foreman with National Gypsum Co.

R. J. Hopkins has been transferred from the Port Pirie office of the Broken Hill Associated Smelters Proprietary Ltd. to the head office in Melbourne, where he is now manager of research.

Foote Mineral Co. recently named **William A. C. Eldon** operations manager of the Cold River, N. H. plant. For the past two years he has been project engineer in the company's central engineering department. He replaces **William R. Hudspeth, Jr.,** who has been named special projects manager of the company's marketing department at its Philadelphia headquarters.

Upon graduating from the Colorado School of Mines, **Warren E. Brown** became a superintendent trainee with Fisher Contracting Co.

Stearns amazing new Indox V magnets boost heavy media recovery



Stearns Indox V wet magnetic drum separator, Model MI.

For cobbing or roughing iron-bearing ore

This new Stearns WPD heavy media separator is made with INDOX V — the amazing new ceramic material which obsoletes all other types of permanent magnets. INDOX V gives you a lighter-weight, lower-cost magnetic separator with a MORE EFFICIENT POLE STRUCTURE AND POWERFUL MAGNETIC FIELD. The results: increased efficiency, lower media recovery cost.

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Big-capacity unit

The model MI, type WPD magnetic separator provides maximum media recovery at high-volume capacity. An important performance feature of the INDOX V WPD unit is its ability to discharge a magnetic concentrate of high specific gravity which, in coal preparation plants, permits plant operation without a densifier. The Stearns WPD incorporates a greater amount of tailing discharge area, and PRODUCES A CLEANER MAGNETIC CONCENTRATE than other wet drum separators. Stearns design provides for a minimum entrapment of non-magnetics in the magnetic concentrate.

Seven models — 30" dia. x 15" to 30" dia. x 72". Experience indicates a slurry feed of 8 gpm per inch of magnet width is a good figure for selection of separator size. See your Stearns representative for full details or write for Bulletin 2012I.

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Obituaries

Blair L. Sackett

An Appreciation by
Frank A. Wardlaw, Jr.

The intermountain area of mining and metallurgical activity lost one of its most honored and highly respected engineers when Blair L. Sackett (Member 1912) passed away on April 27, 1960, in Salt Lake City. He was 73 at the time of his death.

His many close friends and countless men who have worked under him during his 52 years of active business life join in sorrow and loving memory with his widow, Daisy Sackett; his children Earl, Paul, and Virginia; and the six grandchildren.

His early business connections, from the time he graduated from the Colorado School of Mines in 1909, with a degree of Engineer of Mines, were principally with Granby Consolidated in Canada and Cerro de Pasco Copper in Peru. In 1912 he came to Utah, where he was employed by the International Smelting & Refining Co. at the Tooele copper, lead, and zinc concentrator and smelting plant. Then he went up, year after year, until he reached top management. For a number of years before he retired in 1956, he was the company's metallurgical manager in Salt Lake City.

His engineering ability throughout his business life was always supplemented with loyalty to the International Smelting & Refining Co. and The Anaconda Co., the parent organization, together with a very personal interest in the welfare of his management staffs and payroll employes.

In everyday life, his interests included the chairmanship of the Utah Section of AIME in 1933, the Knife and Fork Club, the American Red Cross Society, and administration committees for the Salt Lake First Presbyterian Church.

Raymond E. Franklin
(U.S. Army Corps of Engineers)
Retired

An Appreciation by
Charles M. Romanowitz

R. E. Franklin (Member 1936) died in San Francisco on May 1, 1960. He was born in Cambria, Calif., on Feb. 12, 1885 and led an unusual, effective, and colorful life, both in his military and civilian activities.

His education consisted of grammar and preparatory schooling in San Jose, Calif. He joined the U.S. Navy on Sept. 6, 1900 (under 16 years of age) as a naval apprentice. After six years of intensive study and work in various branches of the Navy, he was honorably discharged on April 20, 1906, with a very high rating. He then took a course in electrical engineering at Oakland Tech, followed by special engineering courses at both Stanford and the University of California at Berkeley in 1908 and 1909.

His mining activities began in Dawson, Yukon Territory, for the Yukon Gold Co., where he worked until 1917, when he resigned to take part in World War I serving with the U.S. Army Corps of Engineers. He was commissioned a captain in January 1918 and went into active duty with the famous mining engineers, 27th Engineers (Combat), Col. O. B. Perry in command. In action in France he rose quickly to major and at the end of the war he was transferred to duty in the office of the Chief Engineer in Washington, D. C. He received his discharge in June 1919.

He maintained activities in the Officer's Reserve Corps, and at the start of World War II, he was again commissioned a major in the Engineers. In June of 1942 he was assigned to overseas duty in Africa serving in South Africa, Central Africa, and West Africa. By June 1943 he was Commissioned Chief Engineer, S.O.S., USAFICA, West Africa. In September of that year he was transferred to the China-Burma-India theater, where he again served with great distinction, and was promoted to the rank of colonel, O.R.C., in 1945. In the fall of that year he returned to the U.S. He was released from active duty on Dec. 31, 1945, with the commission of colonel, and was recommended for appointment as General Officer in the Officers Reserve Corps by the general staff board.

Between World Wars and after World War II he carried on many mining activities in positions including those of chief engineer and assistant general manager of the Pacific Tin Corp., Malayan operations; consulting engineer with an office in San Francisco; field engineer for Dutch Guiana Gold Co., Dutch Guiana; chief mechanical and chief electrical engineer of the Anglo-Chilean Nitrate Corp., Chile; general superintendent of construction, Anglo-Chilean and Lautaro Nitrate Corps., Chile; and field engineer for Yukon Consolidated Gold Corp., Dawson, Yukon Territory. In 1936 he joined the Placer Development Group and was active in the company's various operations until he retired on July 31, 1956. He carried on a limited consulting practice from the time he retired until shortly before his death.

It was my pleasure to have worked with him on his placer mining dredge equipment requirements. During this association the greatness of his active, quick-thinking mind was evident. While he was determined in his ideas, he was nevertheless flexible to changes when they were proved to be sound and practical. The dredging operations and equipment used in connection with his operations showed many new innovations which have been a contribution to the bucketline dredge industry.

He was a kindly, humane man of unshakable integrity and unwavering faith in the essential goodness of human nature. As a result he had an untold number of close friends throughout the world. He was particularly interested in helping younger men develop their careers and those with whom he had personal contact looked up to him as the personification of an officer and a gentleman.

D. H. Angus (Member 1921) died Feb. 22, 1960, in his 83rd year. He had been in failing health for the past year. He was born in Wingham, Ont., and began his mining career with Drummond Mines Ltd. in Cobalt, Ont., in 1911.

F. P. Burrall (Legion of Honor Member 1897) died Feb. 11, 1960, at the age of 87. A native of Michigan, he graduated from the Michigan College of Mines in 1894 and taught chemistry at the College for two years after graduation. He began his mining career with E. J. Longyear in Hibbing, Minn. Subsequently he worked in the West, the Southwest, Mexico, and Europe.

Alfred P. Busey, Jr. (Legion of Honor Member 1909) died June 22, 1959, in Burlingame, Calif. He was born Oct. 15, 1882, in St. Joseph, Mo. Upon graduation from the Colorado School of Mines in 1905, he went to work for Willow Mining Co. in Creede, Colo. In 1908 he moved to California to become manager of Penn Chemical Works, the position he held at the time he joined AIME.

Joseph G. Calverley (Member 1931) died Nov. 28, 1959, after a long illness. He had passed his 73rd birthday just the week before. A native of Pennsylvania, he attended Washington & Jefferson Academy and College in Washington, Pa., graduating from the college in 1912 with a B.S. degree. His early experiences were in the coal industry. In 1928 he joined the U. S. Bureau of Mines in the Pittsburgh office, doing research work on roof falls. Prior to his retirement, he had been an engineer with Wieman & Ward Co., Pittsburgh, for a number of years.

Ira F. Davis (Member 1922), former engineer of coal properties of the Chesapeake & Ohio Railway, died March 19 at the age of 84. Since his retirement in 1947 he had been living in Onancock, Va. A native of West Virginia, he attended the University of Virginia, from which he graduated in 1897. His first job was that of mining engineer with M. T. Davis & Co. in West Virginia. He became associated with the Chesapeake & Ohio Railway in 1920.

George S. Goodale (Member 1930) died Feb. 20, 1960, at El Monte, Calif., following an illness of several years. He was retired from active work and had lived in the Los Angeles area for the past 13 years. He was born in Saginaw, Mich., Sept. 9, 1876. Upon graduation from the Michigan Mining School, in 1896, he worked for several mining companies in the Michigan copper country. From 1930 to 1932 he was a consulting mining engineer to the Soviet government with headquarters in Moscow. In the course of his duties he traveled to Siberia and Turkestan. During World War II he worked for the USBM.

Phillip N. Hosford (Member 1956) died Feb. 23, 1960, at Reading, Pa. He was born July 19, 1932, in Denison, Texas. He attended Texas A & M College from 1950 to 1952; then following his two years of military service he enrolled in Kansas University. After graduation he went to work for Bethlehem Steel Co.

F. S. Lubrecht (Member 1916) died in Hazleton, Pa., where he was born on April 13, 1889. He was a graduate of Lehigh University and as a civil engineer was engaged in private practice for many years. During that time he served as assistant mining engineer for the Luzerne County board of assessors. In 1942 he became mining engineer for the county.

K. L. Marshall (Member 1927), 66, died Dec. 21, 1959, in Ramona, Calif. A native of Pennsylvania, he spent a good part of his professional career in that state. He was a graduate of West Virginia University.

Joseph Petusky (Member 1946) was killed Jan. 22, 1960, when his car skidded and plunged into the pit at the Shenandoah stripping of Reading Anthracite Co. He was general superintendent at the time of his death. He was born in Shenandoah, Pa. Dec. 7, 1904, and graduated from Penn State University in 1929.

W. J. Mead (Member 1916), professor emeritus, Massachusetts Institute of Technology, died Jan. 16, 1960. A native of Wisconsin, where he was born in 1883, he was a graduate of the University of Wisconsin and for many years was a member of the faculty of the geology department there.

D. R. Purvis (Member 1948) died at Silver Bell, Ariz., where he was superintendent for American Smelting & Refining Co. His entire professional career had been spent with that company, beginning in 1939, upon his graduation from the New Mexico School of Mines. He was born Oct. 10, 1916, in Santa Barbara, Calif.

A. R. Matthews (Members 1936), president of Consolidated Coal Co., died suddenly in Honolulu, April 2, while en route to Japan. Born in Nashville, Tenn., May 8, 1902, and a graduate of Lehigh University, he spent his entire professional career in the coal industry. He was a director of the National Coal Assn. and had been chairman of its 1960 annual meeting committee.

Fred L. Fox (Member 1933), 67, died May 30, 1960, at his home in El Paso, Texas. He had been a resident of the city for 40 years. A Canadian by birth, he was a U.S. citizen and a graduate of the University of Texas. His early career took him to Mexico and South America where he was variously employed as assayer-chemist, mill shift-boss, and superintendent. He had been retired for a number of years before his death.

R. E. Franklin (Member 1936) died May 1, 1960, at the age of 75. A native of California, he was a resident of San Francisco at the time of his death. In the course of his career he had seen much of the world. He began his career in the Yukon Territory in 1907 and remained there until joining the U.S. Army during World War I. In 1920 he went to the Federated Malay States as chief engineer and assistant manager for Yukon Gold Co. From 1925 to 1931 he worked in South America. From 1938 through 1955 he was associated with Pato Consolidated Gold Dredging Ltd. as general manager, and by 1953 as director and general manager. In 1957 he retired.

J. Craig McDonald (Member 1938) died May 1, 1960. Born June 6, 1906, in Concord, Canada, he attended the University of Toronto, where he earned his B.A. degree in science. He went to work for Noranda Mines Ltd., Noranda Que., upon graduation in 1930 and continued to be associated with the firm throughout his career.

Necrology

Date Elected	Name	Date of Death
1955	J. G. Bachner	Unknown
1946	P. C. Emrath	July 4, 1960
1907	G. B. Harrington (Legion of Honor)	May 13, 1960
1940	Paul Hett	July 31, 1960
1913	R. B. Hoffmann	June 1, 1960
1960	T. P. Kapantais	July 3, 1960
1956	F. H. Neely	May 9, 1960
1917	J. M. Riddell	July 13, 1960
1955	G. R. Swenson	July 22, 1960
1922	George A. Warner	June 26, 1960

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Proposed for Membership
Society of Mining Engineers of AIME

Total AIME membership on August 31, 1960, was 34,205; in addition 2,545 Student Members were enrolled.

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The Institute desires to extend its privileges to every person to whom it can be of service, but does not desire as members persons who are unqualified. Institute members are urged to review this list as soon as possible and immediately to inform the Secretary's office if names of people are found who are known to be unqualified for AIME membership.

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Continued on page 1128

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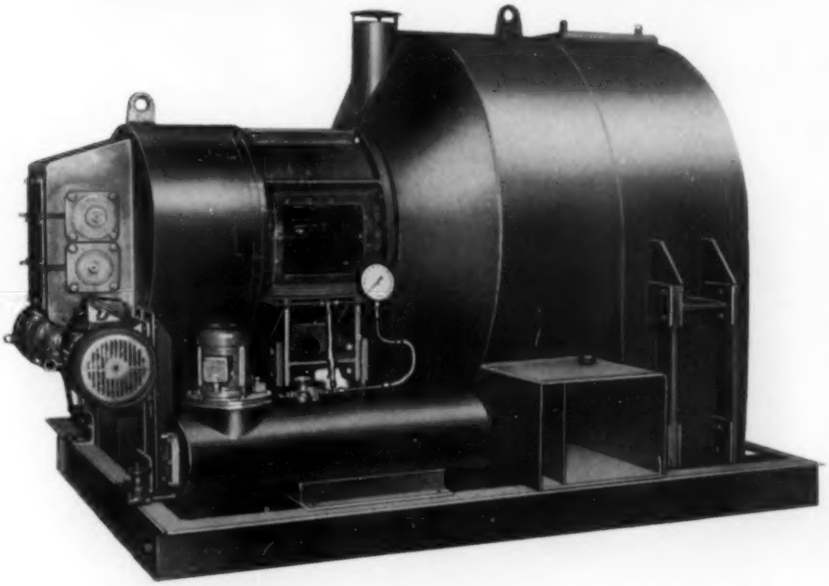

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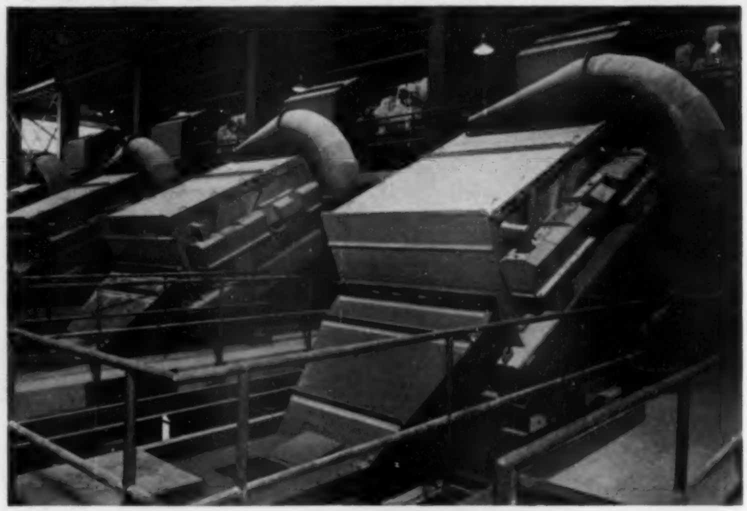

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